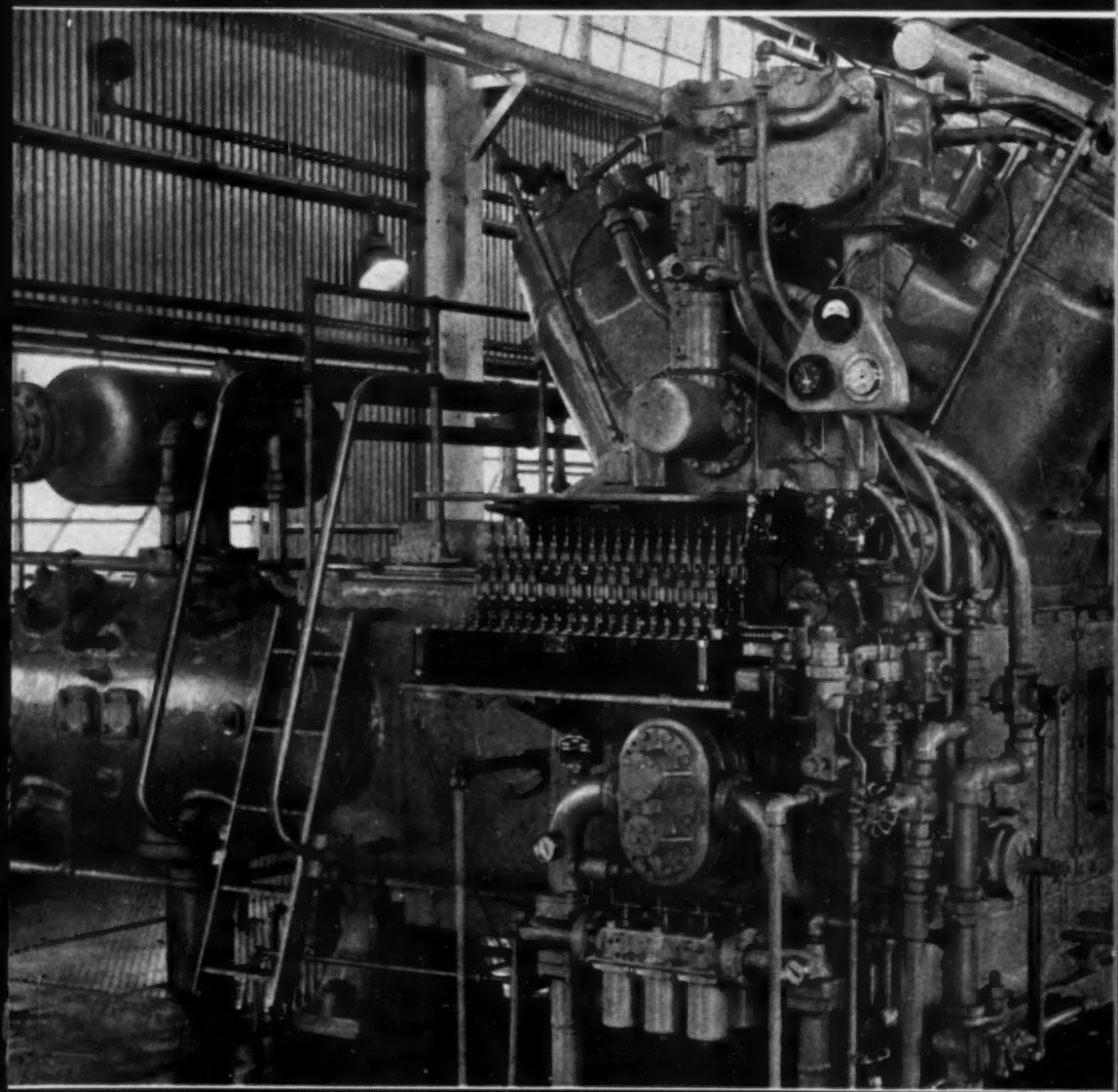
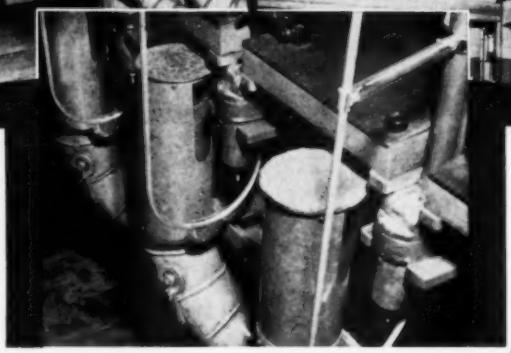
INDUSTRY AND POWER



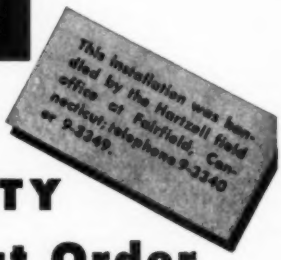
In Connecticut

Here are the 40 4-inch ducts which ventilate the 40 motors under test. Defective motors still burn out, but only defective motors.



This is the single blower, in a single duct, which applies air to the 40 stations. Plenty of power against pressure.

Application of air to motor is mighty simple, as shown here. Yes, mighty simple . . . but mighty effective, too.



HARTZELL INGENUITY
Earns a Repeat Order

Lack of ventilation caused automobile antenna motors in the plant of a Connecticut manufacturer to burn out far too often on the test stand. A bank of 40 testing stations was involved.

The Hartzell field engineer installed a Hartzell VA21-BD vaneaxial blower in a 21-inch duct, bringing in air from the outside. From this, a 4-inch duct delivers air to each of the 40 motors under test.

How well did it work out? Here's the one best answer: The plant operator is planning to install a duplicate bank of 40 more testing stations. Same blower, same ductwork.

Hartzell is set up to give you a *complete* answer to air-moving problems, simple or complicated, wherever you may be. Fans and blowers which move air economically. Experienced, close-at-hand direct factory field service to make sure you get *results*. That means real money to you. Figure your cost—the money you throw away—if the simplest ventilation job wastes just a half-horsepower.

If something in the air is causing trouble, costing money, don't put up with it. Call your nearby Hartzell field office *now*, or mail the coupon below to us at the factory.

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Company_____

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City & State_____

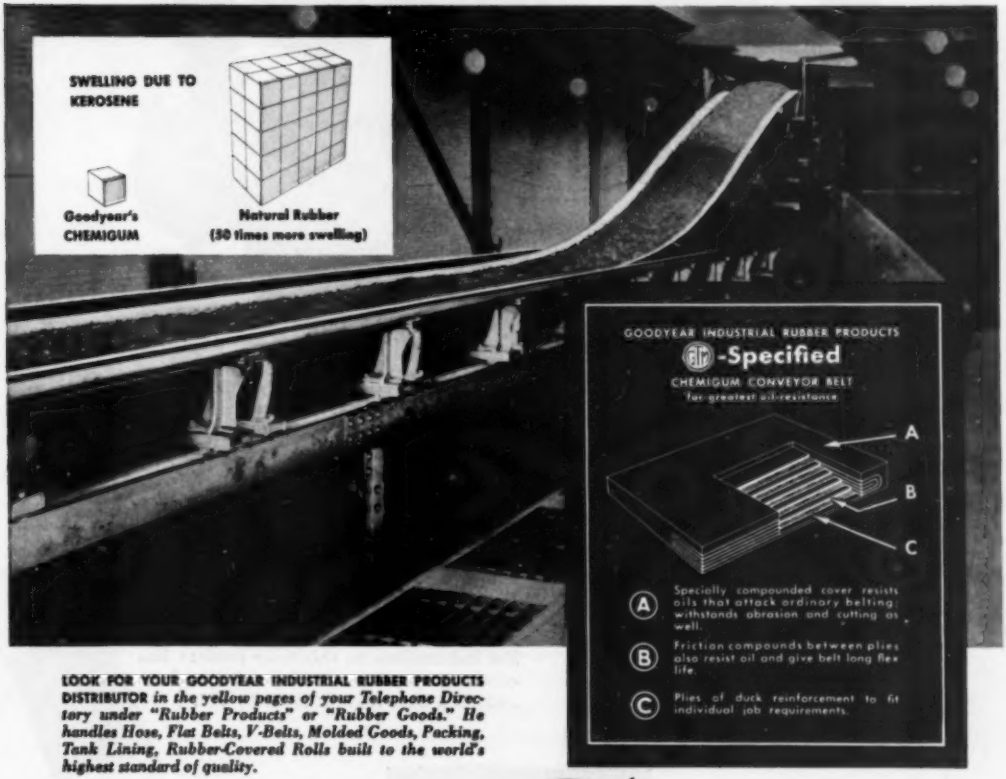
If student, check here for special information ☐

PROPELLER-TYPE FANS AND BLOWERS — ROOF VENTILATORS — UNIT HEATERS • ENGINEERING OFFICES IN PRINCIPAL CITIES

Here's the
LONGEST-LASTING BELT
for handling Oil-Treated Fuel

HERE'S graphic evidence of the oil-resistance built into the covers and carcass of CHEMIGUM conveyor belts—designed by the G.T.M.—Goodyear Technical Man—for use in service where severe oil and grease conditions cause premature failure of conventional belts.

Tests with kerosene show that Goodyear CHEMIGUM covers swell only 2% as much as high-grade conveyor covers made from natural rubber. (See Chart.) CHEMIGUM will also resist oil far better than many other oil-resisting synthetics used in belts. When destructive effects of such solvents are present, consult the G.T.M. for full details, or write Goodyear, Akron 16, Ohio.


SWELLING DUE TO KEROSENE
Goodyear's CHEMIGUM
Natural Rubber (50 times more swelling)
GOODYEAR INDUSTRIAL RUBBER PRODUCTS
AIR-Specified
CHEMIGUM CONVEYOR BELT
For greatest oil-resistance
A
B
C
A Specially compounded cover resists oils that attack ordinary belting; withstands abrasion and cutting as well.
B Friction compounds between plies also resist oil and give belt long flex life.
C Plies of duck reinforcement to fit individual job requirements.

LOOK FOR YOUR GOODYEAR INDUSTRIAL RUBBER PRODUCTS DISTRIBUTOR *in the yellow pages of your Telephone Directory under "Rubber Products" or "Rubber Goods." He handles Hose, Flat Belts, V-Belts, Molded Goods, Packing, Tank Lining, Rubber-Covered Rolls built to the world's highest standard of quality.*

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Chemigum—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

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for extra long life

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- Modern, automotive type, precision bearings.
- Micro-bored connecting rods.
- Extra rugged, heavy duty compressor cylinder valves precision built for long, hard service.

From massive crankcase and crankshaft down to the smallest valve spring, *every* component of Clark Balanced/Opposed Air Compressors is machined and finished to infinitely accurate tolerances.

Such unequaled, precision construction — *plus vibrationless operation through perfect balance* — are your assurance of extremely long life with a minimum of maintenance. Clark Balanced/Opposed, Motor-Driven Air Compressors are designed and built to serve *indefinitely!*

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INDUSTRY AND POWER

The Magazine for Engineered Plant Services

VOLUME 63 **DECEMBER 1952** **NUMBER 6**

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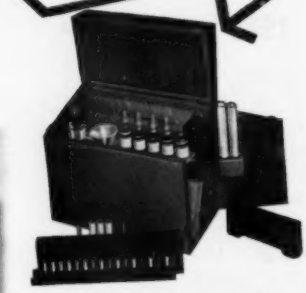
BOILER WATER CONTROL SIMPLIFIED!



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Acorns of science

Developments not yet available, but of interest to those responsible for Engineered Plant Services

Ozone Proofing Rubber

• A recent development by duPont chemists, Hypalon S-2 chlorosulphonated polythene, made a rubber-like material highly resistant to ozone available. Now the news is that it may be blended with other rubber types, imparting a high measure of ozone resistance and broadening the field of application. A blend of rubber widely used in automobile tires and containing 25 per cent of the new material lasted four months in ozone concentrations that caused unblended rubber to fail in a day. Many blends have low temperature flexibility. Promising applications are conveyer belts, wire coverings, engine mountings, unsupported hose and many mechanical rubber products.

Long Range Humidity

• With possible significance for the control engineer, the Signal Corps developed and reported on a device which measures humidity in the upper atmosphere and reports to earth by radio. Principal problem was developing a reliable, sensitive carbon element with a temperature-resistance change.

Control Circuit

• Patent No. 2,604,612 describes a full wave a-c circuit, employing electric discharge tubes in "back-to-back" relation, for controlling power supplied to a load. It is claimed to be particularly useful for controlling speed of a-c motors.

Logarithmic Voltage Reading

• An instrument to measure potentials from thousands of volts down to small fractions of a volt with equal accuracy has been developed by the Naval Research Laboratory. The instrument, an electronic "attenuator" provides output proportional to the logarithm of input voltage. The principle involved could prove important in both indicating and control equipment that must cover wide ranges with a limited percentage of error.

Profile View

• Using low energy gamma rays emitted from cesium 144, Isotope Products Ltd have produced a meter to measure the profile of tire treads. A detector with a narrow slit scans only a fraction of the extruded rubber sheet at a time. Both detector and source swing over the sheet, allowing shape of tread to be recorded.

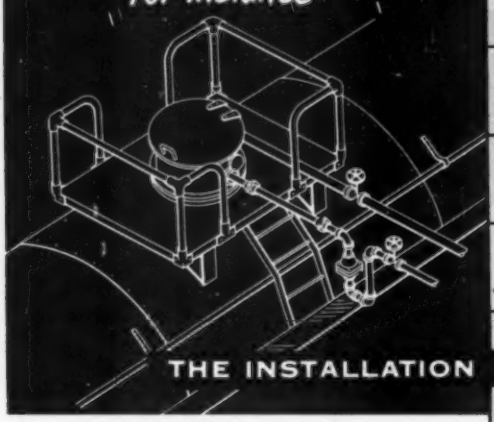
An interesting application of a beta-meter, also using an isotope as a source of radiation, is being tested in an Ontario plywood mill to measure moisture in wood sheet and so control the drying operation.

Snatching Gas Samples

• In order to obtain samples of a rapidly changing gas, in this case to study gas engine "knock", a fast acting sampling valve was developed at the National Bureau of Standards. The valve chamber, connecting combustion chamber to an evacuated sample container, has a lamp chimney shape, small at each end and wide in the middle. A piston seals opening to the combustion chamber until triggered externally. Gas pressure then forces piston upward through wide middle portion, allowing gas to pass around piston to sample container until piston seats in a small upper end. Sampling time is 0.2 milleseconds or less and can be accurately located on the cycle by auxiliary instruments.

Are Your Check Valves Cutting Costs This Way?

...on Corrosive Fluid for instance



THE INSTALLATION

Crane Steel Vertical Ball Lift Check Valve in air pressure line to chlorine tank car, The Mead Corporation, Chillicothe, Ohio.

VALVE SERVICE RATINGS

SUITABILITY:	Doing what's needed
FEATURES:	Non-sticking ball disc
CORROSION-RESISTANCE:	Shows no effects of chlorine
SERVICE LIFE:	Still O.K. after 3 years
MAINTENANCE COST:	Zero – valve never out of service
OPERATING RESULTS:	No loss of chlorine – no unloading delays
AVAILABILITY:	Regular Crane product

THE HISTORY

Unloading chlorine tank cars by pressurizing is common practice. But, formerly, it wasn't safe for this mill. When the compressor was shut down, chlorine would back up into the air system.

Corrosion product would form on the working parts of the check valve in the air line. The disc would stick in open position, letting the chlorine back up. This meant frequent dismantling of the check for servicing. It meant a lot of extra cost in time, labor and unloading delays.

But the trouble was stopped with a Crane Steel Vertical Lift Check. Its polished ball disc of solid Exelloy doesn't stick; always seats tight. For more than 3 years this check has never failed to stop backflow, and still it's good as new.

THE VALVE

Crane No. 3692XS Cast Steel Vertical Ball Lift Check. Compact and sturdy, with heavy metal sections. Has leakproof male and female joint with corrugated soft iron gasket. Ball disc is solid hard Exelloy, highly polished, with guided seating to integral seat ring. Sizes up to 2 inches. Consult your Crane Catalog or Crane Representative for full details.

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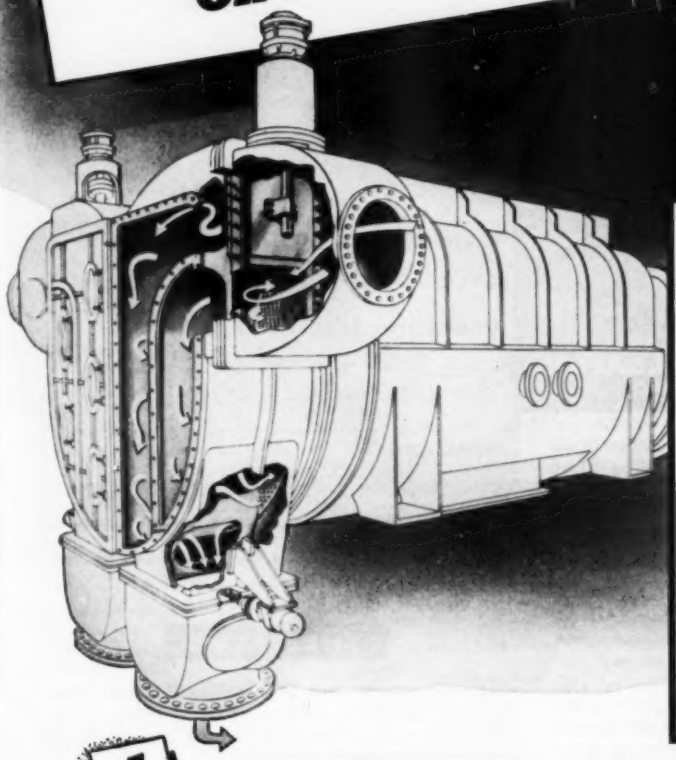
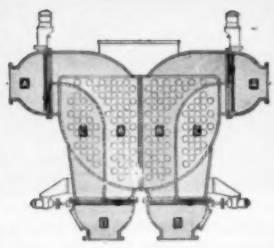




HERE IS HOW REVERSE FLOW WORKS

Reverse flow sluice gates on divided water box condensers work the same in both halves but independently of each other. Right side: normal flow. Water enters divided water box in valve chamber "A" with lower port open. It flows through pass "C" to end of condenser, back through pass "B" and out through left port of "D."

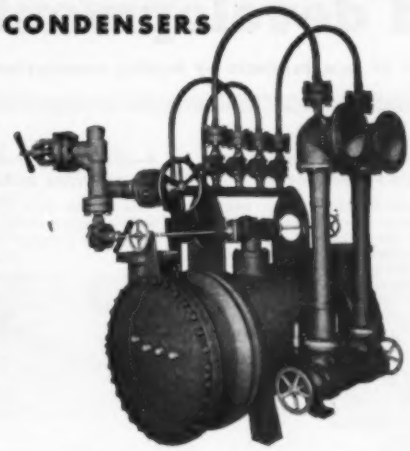
Left side: flow is reversed. Valves at inlet "A" and discharge "D" are changed to permit water to flow through "B" and back through "C" in the opposite direction and then out through the left port of "D."

1 CLEAN DEBRIS FROM CONDENSER TUBE SHEETS WITHOUT DOWNTIME OR LOSS OF VACUUM

C. H. Wheeler "Reverse Flow" Condenser design provides a powerful self-cleaning flushing force by the simple procedure of reversing the flow of water through the tubes. Electrically or hydraulically controlled sluice gates accomplish in minutes cleaning that consumes hours of downtime when removal of debris is done by hand. Power plant modernization calls for the efficiency and uninterrupted operation of C. H. Wheeler "Reverse Flow" Condensers. You don't need costly water straining apparatus. Send for latest bulletin #410.

2 VACUUM PUMPS WITH LOWEST MAINTENANCE FOR YOUR STEAM CONDENSERS

C. H. Wheeler Steam Jet Ejectors are the development of 35 years of pioneering in this field. Known as "Tubejets," these vacuum pumps have no moving parts. Hence, they are simple to operate, require almost no maintenance and last longer. Modern Power plants use single or two-stage Tubejets with surface inter-after condenser for the vacuum requirements of steam condensers. Special arrangements of standard Wheeler ejector assemblies can be provided for any unusual installation or performance requirements. Catalog #1462 gives you detailed descriptions and some useful temperature and pressure conversion tables. Write for it.



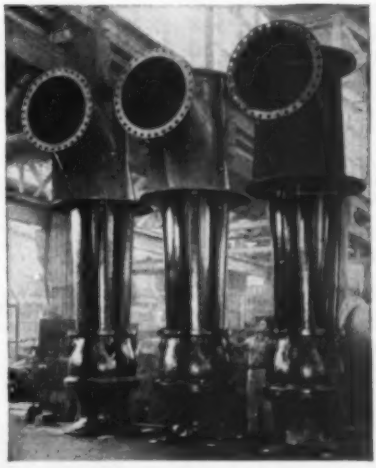
SPECIAL TYPE TUBEJET VACUUM PUMP FOR HIGH PRESSURE AND HIGH SUPERHEAT

3 WHEELER-ECONOMY CIRCULATORS HANDLE LARGER VOLUMES OF WATER AT LOWER COST

Wheeler-Economy Pumps for Condenser Cooling Water Circulation are made in horizontal double suction and vertical submerged, axial mixed flow types. These pumps are noted for reliability, the result of superior modern design and heavy duty, quality construction. They are built in all sizes to meet capacity requirements up to 200,000 GPM. Wheeler-Economy Circulating Pumps are also furnished in special metals to handle corrosive waters. The impellers are designed for satisfactory operation during all load requirements.

Economy engineers are pioneers in the successful application of axial flow pumps in circulator service. These pumps can be furnished in "pull-out" type with distinctive design features, permitting removal of all operating parts, without dismantling the complete pump or disturbing any pipe connections.

For top performance in power plant duty count on Wheeler-Economy Pumps. Write for catalogs #G-349 and G-1050.



THREE CIRCULATORS OF 28,000 G.P.M. CAPACITY. 35 FT. TDH, 575 RPM.

105-R

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C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

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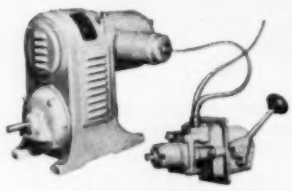
New equipment and developments

Highlights of new products by leading manufacturers

Each new product item has a key number for your convenience in asking for additional, detailed information. Insert key number on return post card on page 123

1—Unit remotely controls variable speed motors

U. S. Electrical Motors Inc. has developed a pneumatic remote speed control for use with their Varidrive motors. Operation is with either 60 or 100 psi air pressure. Pedal, lever, cam or wheel valves are available for operating the mechanism. Speed of a unit can be controlled from any number of stations, or conversely, any number



of units can be controlled from one station providing they are to operate at the same speed.

2—Humidistat features simple construction

For on-off control of electrically powered humidifiers and dehumidifiers, Abbeon Supply Co. has developed a simple, automatic humidistat. Equipment to be controlled is plugged into the unit which, in turn, is plugged into a 110 v outlet. Range extends from 10 to 95 per cent relative humidity.

3—Insulated anchor reduces heat loss

To minimize heat loss at anchorage points and prevent pipeline corrosion due to electrolytic action, Durant Insulated Pipe Co. has developed a new type of insulated anchor. For use in underground insulated pipe systems conveying hot or cold liquids of gases, it is constructed to eliminate contact between anchor plate and pipe, thus insulating the pipeline both thermally and electrically.

4—Soldering iron provides quick heat

Requiring only 40 sec to reach soldering temperature, the R-115A two-speed soldering iron developed by

Snap-on Tools Corp. weighs only 9 oz. Depressing a control button delivers 100 w to the tip for fast heating. Once the iron is heated, it requires 25 w to maintain the temperature. Seven styles of interchangeable tips are available. Two models are offered; one for operation on 115 v a-c, a second for aviation use with airplane power supply. Literature is available.

5—Transformer is for secondary circuits

Westinghouse Electric Corp. has developed an enclosed, non-ventilated dry type distribution transformer, the type E, which will supersede the type AJR transformer. Designed for indoor or outdoor service on secondary circuits rated 600 v and below, models are available in ratings of 3, 5, 10, 15, 25, 37½ and 50 kva. The three smaller sizes are designed for wall mounting, while larger sizes are for floor or platform mounting. The 15 and 25 kva units can also be wall mounted.

6—Kits containing magnets aid industrial planners

To enable industrial planners to devise their own uses for permanent magnets, the Carboloy Dept. of Gen-

eral Electric Co. is marketing two "You-Try-It" kits. One kit contains 48 permanent magnets in eight styles, while the other contains 18 larger magnets in four styles. Descriptive literature is available.

7—Electric immersion heater is for electroplating

Design of an immersion type electric heating unit for electroplating baths has been announced by Edwin L. Wiegand Co. The CTL heater uses a thick lead sheath to resist corrosive acid action of copper, chrome, and nickel

solutions. The unit is said to offer many advantages over steam heating. Separate thermostatic control is possible for fully automatic temperature regulation. The heater is rated at 5 kw on 230 v. A data sheet is available.

8—Demineralizer provides high purity water

For users of up to 100 gph of extra high purity water, Penfield Manufacturing Co., Inc. has developed the M-100 Mono-Column demineralizer. The unit, which measures 2 x 2 x 7½ ft, has a capacity of 4500 grains. In operation, raw water passes through a column of mixed cation and anion resins. A flow meter permits control of water intake for efficient operation, and an electric purity meter provides continuous indication of water purity at the effluent. When purity falls below standard, regeneration is accomplished by a single operation, consuming less than one hour, by means of a simple regeneration system built into the unit. Operating costs are said to average less than 30¢ per 1000 gal of water. The mineral-free water is said to be equivalent to triple distilled water.

(Continued on page 14)

Sound Selling vs. Smart Talk

Today, essentially, all of the chemical companies have established technical service and sales-supporting technical work. One corporation has 25 laboratories devoted to this type of work supported by 29 field laboratories. The total investment by the industry in such facilities, must run well into the tens of millions of dollars, which is one measure of how importantly the industry regards the sales function.

It is now estimated that 70% of the average chemical company's sales staff is technically trained compared with probably less than 25% only 20 years ago and an insignificant percentage 30 years ago. This current mode of selling is epitomized in the slogan of one chemical manufacturer, namely, "Serving Industry through Practical Applied Science."

From an article: "Selling . . . Its Importance in the Chemical Industry," by J. Warren Kinsman, Vice-President, E. I. du Pont de Nemours & Co., Wilmington, Del., in Chemical Engineering Progress.

Nalco appreciates the use of its slogan, "Serving Industry through Practical Applied Science", as an example of the modern approach to chemical sales. 100% of Nalco's field service representatives are technically trained to help industry make full practical use of the chemicals and methods developed by the Nalco Laboratories: Water, Microbiological, Physical Chemistry, Organic Chemistry, Corrosion, Micrography, Metallographic, Experimental Boiler, Combustion, Oil Treatment, Paper, Ion Exchange, Weed Control, Production Control.

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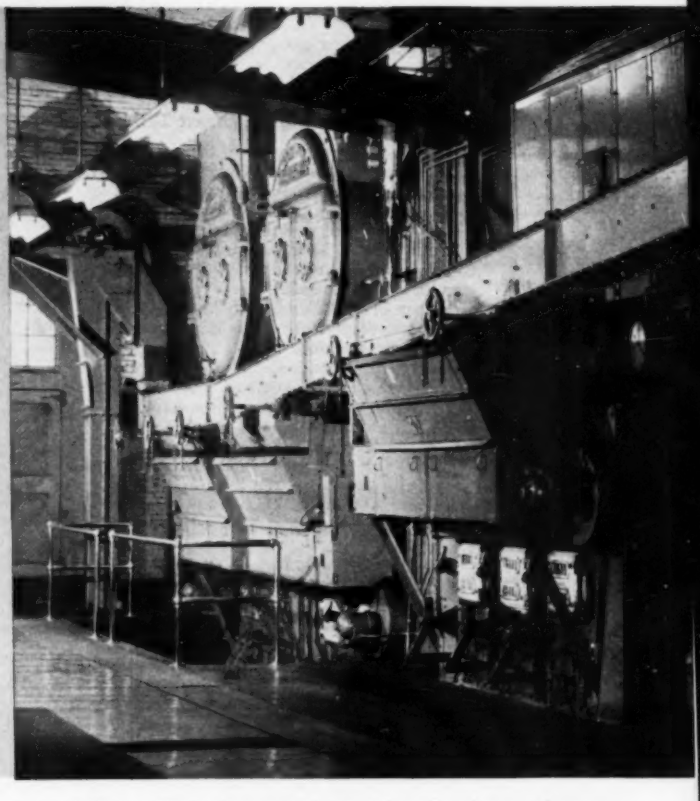
In Canada: Alchem Limited, Burlington, Ontario

THE *Nalco*® SYSTEM . . . Serving Industry through Practical Applied Science

"WE SAVE MORE THAN $50,000 A YEAR—

This modernized steam plant will pay for itself in 3 years! The two new boilers shown on the extreme right now carry the complete plant load. They replaced five boilers of the type shown on the left—two of which are still in standby service. The new equipment saves Worumbo nearly 30¢ on every thousand pounds of steam. Automatic, dustless coal and ash handling has helped cut weekly labor costs from $606 to $242! The new plant has a 20% greater capacity—burns 150 *fewer* tons of coal each month.



• Today coal can give you more steam per dollar than ever before. With modern combustion equipment, you can get anywhere from 10 to 40% more power from a ton of coal than was possible a few years ago. And with up-to-date automatic coal- and ash-handling systems you can cut labor costs to a minimum.

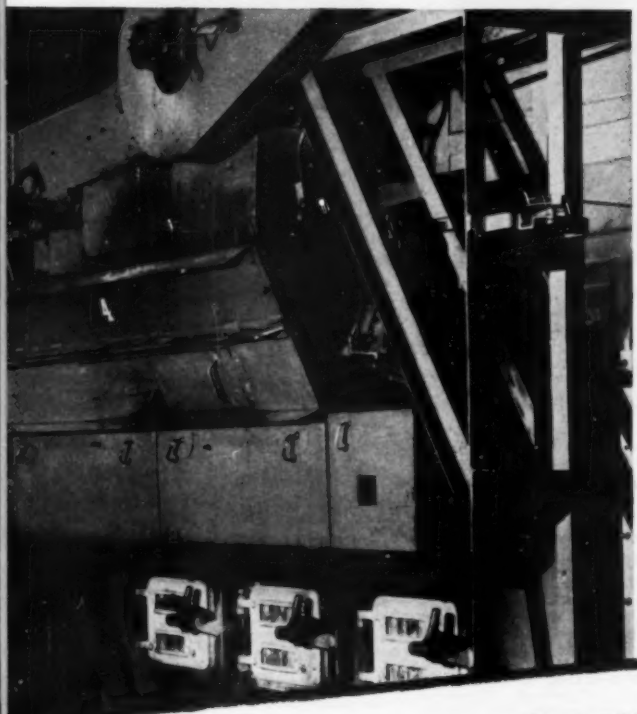
If you're building a new plant, or planning to modernize, get the advice of a consulting engineer. He'll show you the way to *big* savings—burning coal in a modern plant designed to meet your specific needs.

Powering your plant with coal makes good sense for the future, too. Coal is the only fuel with really abundant reserves—enough to last for centuries. And this coal is supplied by the world's most efficient and productive coal industry. That's why coal is the only fuel that can offer dependable future supply and greater relative price stability.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
WASHINGTON, D. C.

FOR HIGH EFFICIENCY—FOR LOW COST

BY BURNING COAL THE MODERN WAY!"



"MODERNIZING OUR COAL INSTALLATION CUT OUR FUEL CONSUMPTION 21.4%...LABOR COSTS 60%!"

says Oliver Moses, 3rd, President, Worumbo Manufacturing Company, Lisbon Falls, Maine—makers of nationally advertised WORUMBO FABRICS.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

YOU CAN COUNT ON COAL!

New equipment and developments

(Continued from page 10)

9—Control extends variable speed drive applications

Reeves Pulley Co. has announced that all integral horsepower Vari-Speed Motodrives can now be equipped with Conoflow controls. Connection

can be made with any pneumatic control instrument having air pressure of 3 to 15 psi. This arrangement permits use of the drives for controlling liquid levels, flow proportioning systems, pressures and temperatures.

10—Instrument measures electrostatic charges

Electrostatic charges, often the cause of industrial explosions, can be detected and measured by the Baldwin-Dunlop Statigun, marketed by Herman H. Sticht Co., Inc. The instrument, consisting of a pistol-like body and grip which contains batteries and working parts, is pointed toward the object suspected of carrying the charge. Voltage gradient is read directly on a dial having a scale of 0 to 2000 volts per foot.

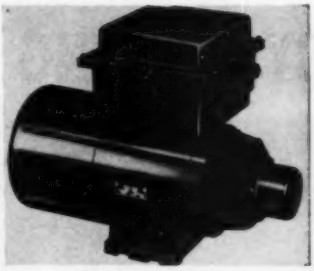
An adjustable sleeve gives readings of 1, 10 and 100 times scale reading. Construction is described in a data sheet.

TO REQUEST ADDITIONAL FREE DATA

Insert "key" numbers on return post card found on page 123. Our Reader's Service Department will handle your request promptly

12—Power conversion package has many applications

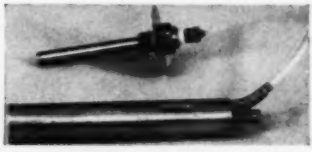
Engineers of Eicor, Inc. have developed a power conversion unit said to be suitable for many applications. This 300 w converter has a d-c input of 115 v, within plus or minus 15 per cent, and a 60 c, regulated a-c output of 115 v, single phase, operating at 0.9 lagging power factor. Regulated output is achieved by compounding the booster field windings. Mounted on top of the



unit is a box containing a filter for suppression of radio noise, starting contactors, output voltage control and other necessary circuit components.

13—Midget thermostat requires minimum space

Outside diameter of the heat sensitive shell of a midget Thermoswitch is only ¼ in., according to the manufacturer, Fenwal, Inc. It is designed for precision temperature control or overheat detection in solids, liquids or gases where space is at a premium. Any set-point from -50 to 450 F is

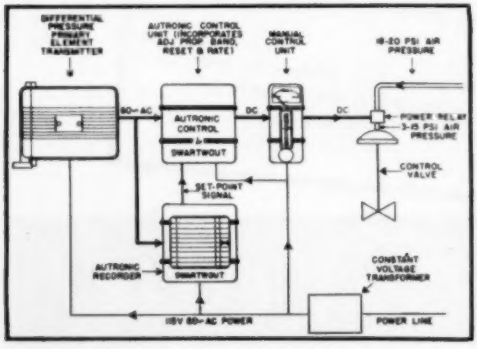


available. Sensitivity is said to be within 0.1 F. Rating is 1 amp at 48 v a-c or 32 v d-c. The illustration compares the unit to a standard cartridge thermostat with 5/8 in. OD.

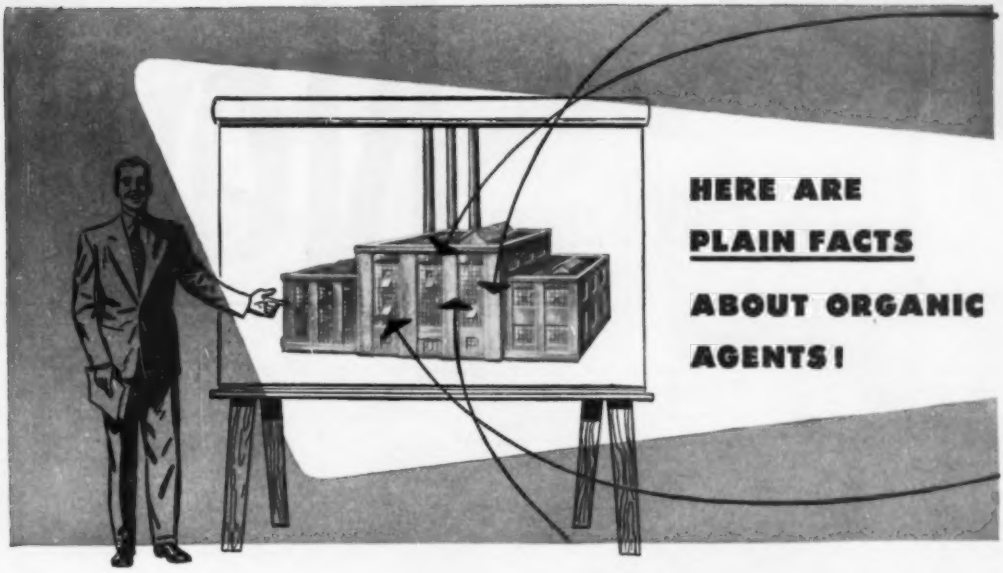
(Continued on page 22)

11—Differential pressure transmitter is developed for control systems

Type D2T, a differential pressure primary element transmitter developed by The Swartwout Co., is designed for use in automatic control systems. To be used primarily in their Autronic control system, it covers a differential pressure



range of 0-20 to 0-200 in. water at static pressures up to 1500 psi. Installed at the point of measurement, the unit transmits an electric signal which is directly proportional to the variable being measured. In operation, minute movements of a diaphragm are transmitted through an amplifying linkage to a movable core of the differential transformer, which provides a 0.000 to 0.500 v, 60 c signal output required for operation of other units in the system. It is compact in size, measuring 13 x 6½ x 5¾ in.



HERE ARE PLAIN FACTS ABOUT ORGANIC AGENTS!

Many times the full and proper use of organic agents is not included in a water conditioning program. And many times the results are far from satisfactory.

Take, for example, the case of a large paper manufacturer who was having considerable difficulty with blistered tubes which resulted in plant shutdown. The major difficulty with tube burnouts was confined to a single 500 psi unit rated at 200,000 pounds of steam per hour. Thin, hard scale developed in the first row of generating tubes exposed to the most intense heat.

With internal treatment by inorganic agents alone and the continuous maintenance of adequate soluble phosphate content of the boiler water, forced outage due to tube burnouts occurred three or four times yearly. And, the boiler was turbined at least twice yearly.

Betz engineers studied the problem and recommended the use of organic agents to supplement the external softening and inorganic treatment. Results? Since the application of organic treatment, no tube losses have occurred due to internal conditions for seven years! In fact, the boiler has operated for over three years without turbining or acid cleaning! Under present plant operation, the need for turbining or acid cleaning is not anticipated.

If your plant is plagued by scale and sludge deposits, why not do something about it *now*, by calling in a Betz Engineer. He'll show you factual evidence how Betz *Specialized* Water Conditioning Service can help you solve your water problem. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

Write today for a copy of Betz Technical Paper No. 98, "Boiler Scale —Its Formation and Prevention."

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

Possible applications for FIBERFRAX fiber

THERMAL INSULATION

- Used loose, bonded, packed, or as a blanket for insulating furnaces, jet engines, etc.
- Tape for wrapping pipes and other parts requiring high temperature insulation.
- Fireproofing for safes and containers.
- Packing for expansion joints, kiln cars, etc.
- As a paper, fire curtain, or bonded into a fire wall.

REINFORCING AGENT

- To reinforce electrical insulators, battery plates, etc.
- As a base for sprayed-on ceramic coatings.
- With resins to produce fiber-plastic materials.
- With deposited metals to make porous structures.
- In brake linings.

AS A FILTER

- To filter gases (can be burned clean and reused).
- Filtration of liquids (oils, acids, etc.).
- Flame filter to remove ash (as in gas turbine).

MISCELLANEOUS

- As a wick or other capillary body.
- Cushioning or vibration dampening material.
- Bonded into acoustical tiles.
- As a diffusing material (high corrosion resistance).
- As a catalyst support.
- For dielectric materials.

This listing does not represent all possible uses. These are simply suggested applications, many of which are untried.

versatile ceramic fiber — insulates, makes superfine filter, resists 2300°F (and more)!

This cotton-like material is a ceramic fiber, a new synthetic with a host of interesting possibilities. Brand new, this remarkable fiber (trademarked FIBERFRAX) easily withstands 2300 F without loss of properties, and up to 3000 F without melting — temperatures far higher than possible with existing mineral or glass fibers. Applications already tested range from — use as a superfine filter (even fine enough to filter bacteria) — to insulating blankets for combustion and exhaust systems of jet engines — to dielectric papers (with electrical losses ¼ those of Kraft paper).

FIBERFRAX fiber is made by melting aluminum oxide and silica (both non-critical materials) at 3300 F. The molten mix is then poured and blasted with an air jet. Instantly, a mass of fluffy white fibers is formed. These fibers are as long as 3", yet average only 4 microns in diameter (about 1/25 the diameter of a human hair). Weight, as blown, is just 2 lbs per cu ft.

This random mass of fibers has many talents. Experimentally, it has been bonded into batts, made into felted rolls or blankets, and even made in paperlike forms (such as tape). When packed to density of about 6 lbs per cu ft, it can make a better heat insulator for many furnaces than high grade insulating brick. Because of its pronounced capillary qualities, it seems suitable for use as a wick. FIBERFRAX fiber is also virtually impervious to most acids. It could be used as a catalyst carrier. And it seems a natural substitute for asbestos — or it could be combined with this rather critical material.

Inherently an excellent electrical insulator, FIBERFRAX fiber will find many dielectric applications. It also lends itself to use as a reinforcing agent — for example, in battery plates, or in low pressure laminates, or perhaps as a base for sprayed on ceramics. It is resilient and makes a good cushioning or packing material, particularly for high temperature spots. It could be used for fire proofing, or bonded into a firewall. FIBERFRAX tiles also deaden sounds. In bulk or paper form it makes an unparalleled filter for gases, liquids, flames, etc.

Do any of these applications suggest possibilities to you? If so, please write or phone us. Though FIBERFRAX fiber is presently available only in bulk form, all the forms mentioned here (and perhaps others) will soon be commercially available. Why not check up now?

CARBORUNDUM
Trade Mark

"Carborundum" and "Fiberfrax" are trademarks which indicate manufacture by The Carborundum Company

FIBERFRAX material magnified 500 times. Note the diverse size and random arrangement of fibers (ideal properties for a filter material).

FOR COMPLETE INFORMATION — USE THIS COUPON—

Dept. X-122, Refractories Division
The Carborundum Co., Perth Amboy, N. J.

Please send free folder on FIBERFRAX fiber.

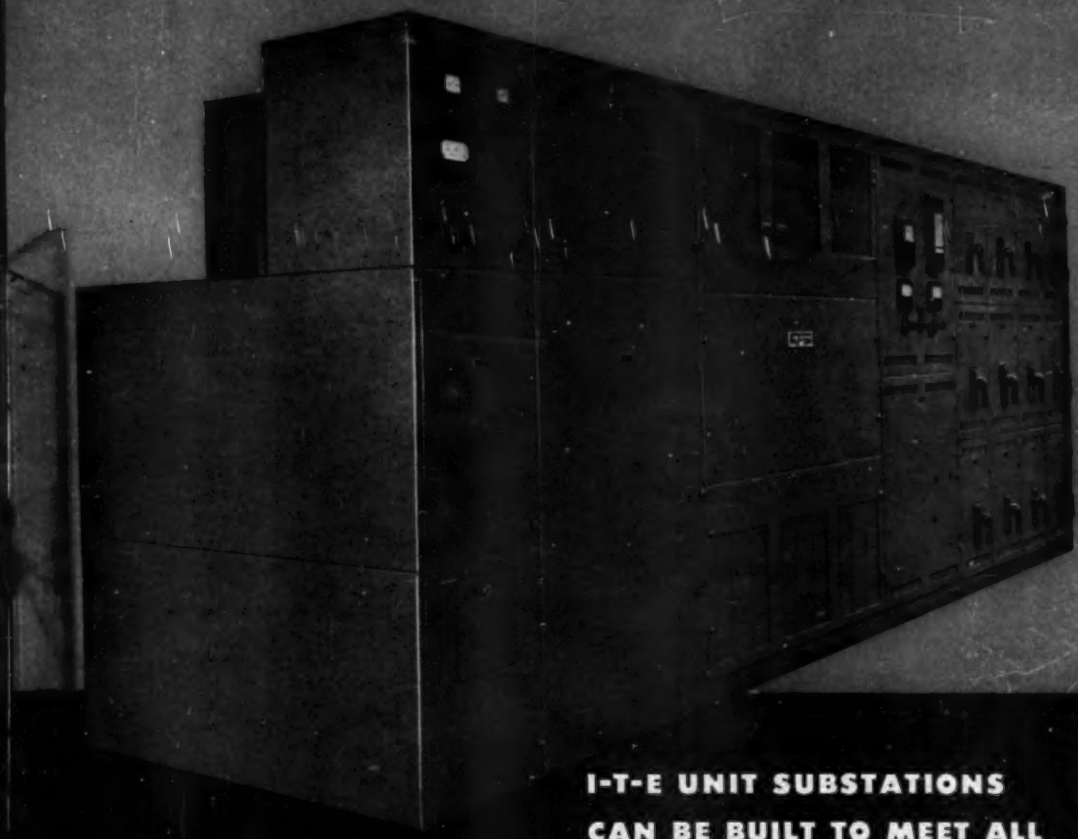
Name_____

Position_____ Company_____

Street_____

City_____ Zone____ State_____

HOW MUCH WOULD A POWER



TRANSFORMER TYPES INCLUDE:

OISC
Non-inflammable liquid-filled
Class B air-cooled (illustrated above)
Class H air-cooled
Class H, nitrogen-filled, sealed tank

I-T-E UNIT SUBSTATIONS CAN BE BUILT TO MEET ALL NEMA "USUAL and UNUSUAL" SERVICE CONDITIONS

Indoor and outdoor – in any required ratings

YOU SAVE THROUGH—

1. Better voltage at point of use.
2. Lower conductor cost—shorter runs of LV cable.
3. Shorter installation time—Substations shipped as complete packages.
4. Use of lower interrupting capacity breakers.

GET THE FULL STORY—

See your local I-T-E representative for details—or write for Catalog Section 9000 today.

FAILURE COST YOUR PLANT?

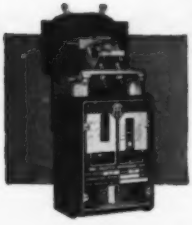
Suppose a prolonged power interruption suddenly hit your plant! How much would it cost you in lost production, down-time—perhaps ruined product, equipment damaged beyond repair?

To all plants, *service continuity* means profits. In some, service continuity is the most important single consideration in planning the vital electrical distribution system.

Assure service continuity—Install modern I-T-E Unit Substations

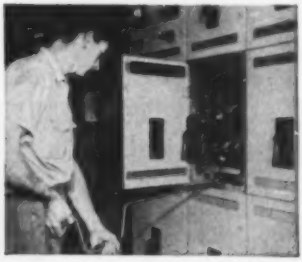
No matter what your service continuity requirements may be, I-T-E can offer you the benefits of long experience—supply the equipment to meet them all. You get:

FLEXIBLE SYSTEM PLANNING. *Sectionalization* (I-T-E Unit Substations strategically spotted throughout the plant) *limits* the area affected by power interruption. You can plan your system to provide immediate restoration of service—or actual *elimination* of interruption on unaffected circuits.



SELECTIVE TRIPPING. Sectionalization can be carried right down to the *individual* I-T-E circuit breaker—the individual machine or feeder. The versatile I-T-E Direct-Acting Selective Overcurrent Trip Device helps *isolate* faults. If there's a sustained overcurrent or short circuit in any branch of the system, only the breaker closest to the fault will open.

MODERN DRAWOUT CONSTRUCTION. Even maintenance requires little or no down-time. With modern I-T-E drawout construction, total outage time during maintenance is only a few minutes. Circuit breakers of like characteristics are interchangeable. One spare breaker—for quick replacement—provides economical insurance for a number of feeder circuits.



I-T-E

UNIT SUBSTATIONS

I-T-E CIRCUIT BREAKER CO. • 19TH & HAMILTON STS. • PHILA. 30, PA.

CANADIAN MFG. & SALES: EASTERN POWER DEVICES, LTD., TORONTO • EXPORT SALES: PHILIPS EXPORT CORP., N. Y. 17, N. Y.

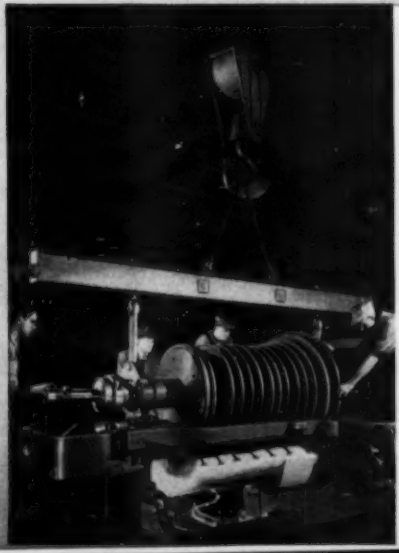
From Shop

HERE'S HOW Allis-Chalmers Builds the Generator Unit that's Easy to Install, Low in Foundation Cost

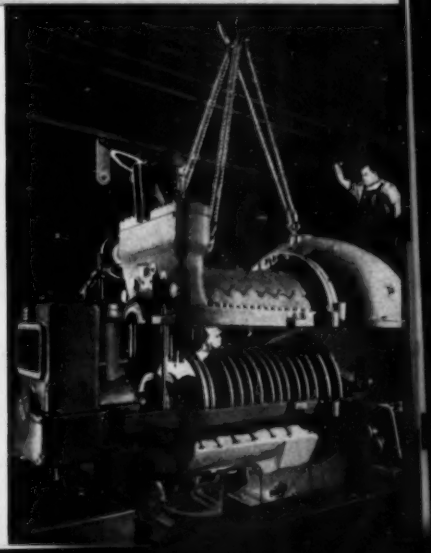
MODERN Allis-Chalmers WA-Series steam turbine generating units are factory tested and shipped with rotors locked in place to save you installation time. Oil piping and generator air coolers are both above the floor line to reduce your foundation costs.

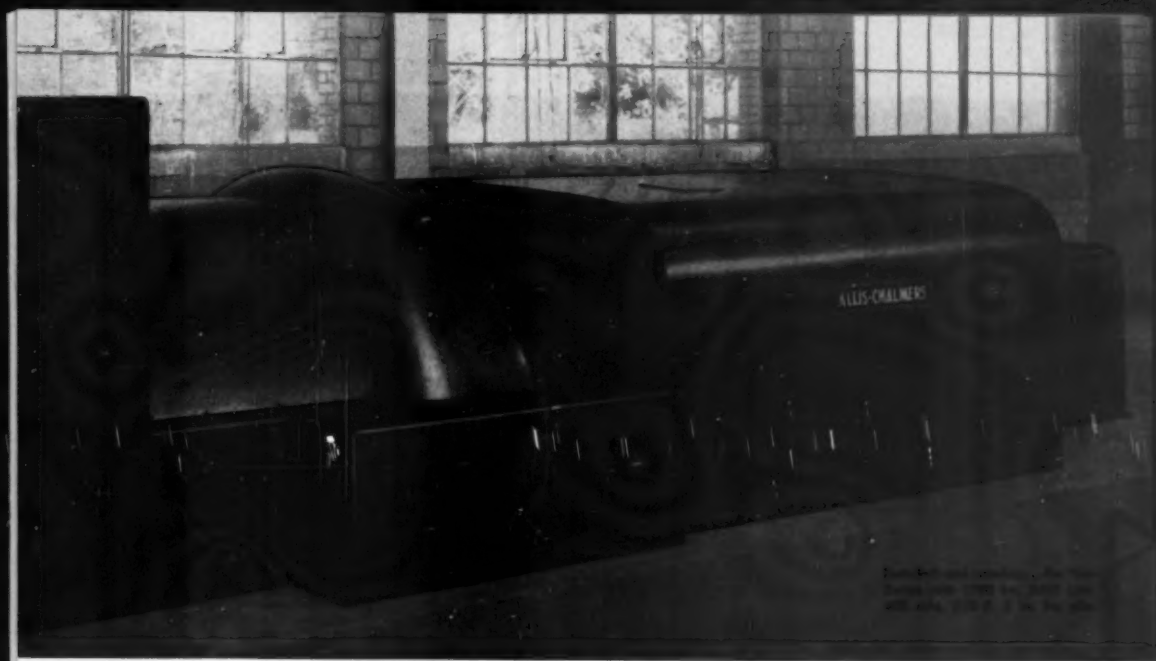
WA-Series units are built in ratings from 2000 to 7500 kw for either condensing or non-condensing operation. For your copy of Bulletin 03B7654, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3910

1 Precision balanced turbine rotor assembly being lowered into casing. All wheels have durable chrome alloy steel buckets.



2 Upper half casing of this compact impulse steam turbine is next added in the process of assembling the WA-Series unit.

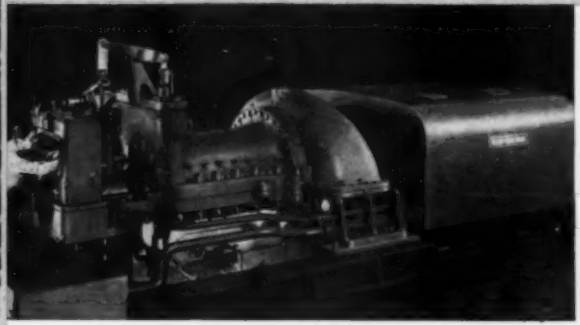


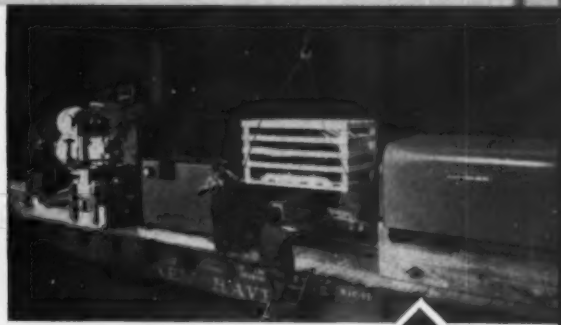


to Shipment!

3 Assembled 3-bearing unit — complete with housing type air cooled generator — ready for factory testing. Both oil piping and generator air coolers are above the floor line.

4 Entire WA-Series 3000-kw unit—pre-tested and insulated—being loaded on one flatcar for unit shipment. Both turbine and generator are shipped with their rotors securely locked in place.





ALLIS-CHALMERS

World's Widest Range of Power Plant Equipment

A-C ALLIS-CHALMERS

New equipment and developments

(Continued from page 14)

14—Photoelectric unit has higher counting speed

Actuation of electric counters and other devices directly in the plate circuit is provided by a photoelectric unit,

the Shadowswitch, according to the manufacturer, The Autotron Co. Elimination of the conventional relay is said to provide higher counting speed and increased service life. Literature is available.

15—Motor blowers are for electronic equipment

Induction motor blowers, from 1/100 to 1/15 hp, have been developed by Cyclohm Div. of Howard Industries,

Inc. for application in such electronic equipment as micro-wave relays. The units, model 2914, operate at 1650 rpm with 90 to 120 v input. Air delivery of each head of the double blower is 37 cfm at 95 v a-c.

17—Unit provides complete chemical feed system

Milton Roy Co. has combined all the basic elements of a chemical feed system into one compact unit, said to offer

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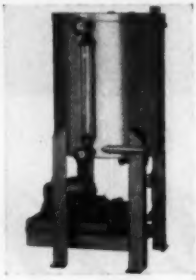
considerable savings in installation time and space. Basically it consists of a 50 to 500 gal chemical solution tank



mounted over a controlled volume pump. Pump capacities up to 300 gph are available for pressures to 5000 psi.

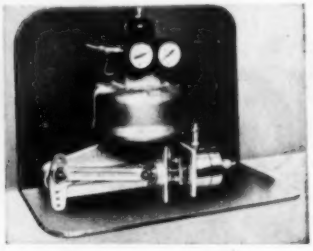
18—Condensate return units require minimum space

Condensate return units, developed by Aurora Pump Co., are said to combine the latest features in vertical tur-

bine pump design with minimum space requirements, automatic operation and minimum loss of heat. Known as Apco-Matic, they are close-coupled for quiet operation. Units are available for heating system condensate with ratings of 800 to 10,000 EDR and pressures to 50 psi.

19—High pressure valve is for low flow control

Designed especially for pilot plant operation, the Wee Willie high pressure, low flow control valve introduced by Annin Co. is available for working pressures of 10,000 to 30,000 psi, with special assemblies to 50,000 psi. The



unit, which is pneumatically controlled, is available in sizes from ⅛ to ½ in. for various types of connections.

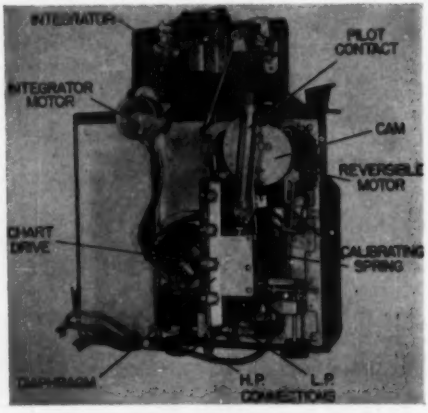
(Continued on page 27)

16—Low differential flow meter features increased accuracy

For measuring air and gas flow, or recording ratio of air flow to gas flow, The Hays Corp. has developed the Diaflow low differential flow meter. It is said to be especially adaptable for industrial furnaces and sewage disposal plants. A wide variety of models are offered to fit many measuring requirements. In addition to measuring a single flow, units can be provided with two elements so that gas and air flow records can be combined and coordinated for efficient combustion.

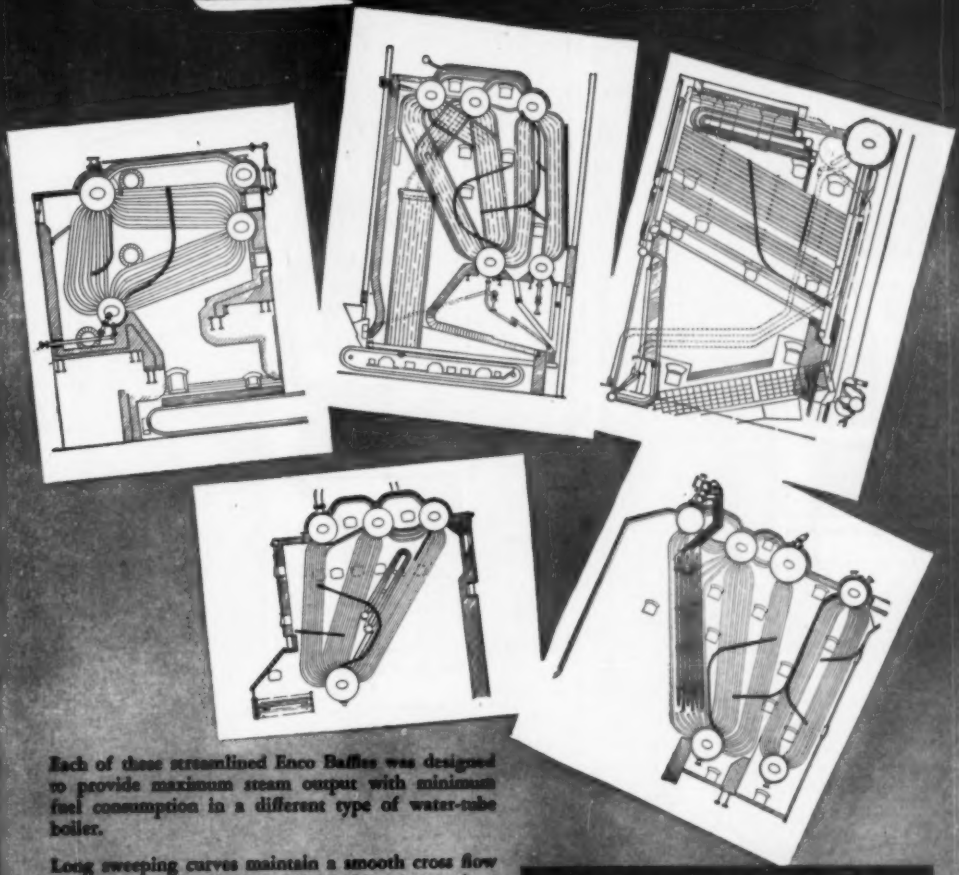
High accuracy with negligible friction is obtained by a pilot method of operation in which no load is placed on the measuring element. Static pressures to 10 psi and differential pressures to 20 in. water can be accommodated by a differential type diaphragm.

Unit construction permits parts removal without affecting calibration, and a swinging frame gives accessibility to internal parts. A cam changes the square root relationship between differential pressure and flow to an easily read equal-increment flow record.



Streamlined for Savings

IN EVERY TYPE OF BOILER



Each of these streamlined Enco Baffles was designed to provide maximum steam output with minimum fuel consumption in a different type of water-tube boiler.

Long sweeping curves maintain a smooth cross flow of gases across every square foot of heating surface. Eddy currents, bottlenecks and dead gas pockets are eliminated—draft losses are cut to a minimum. Soot blowers work more effectively, less steam and less time are needed for cleaning.

Enco Streamline Baffles are individually designed and engineered to the exact requirements of your boiler. Experienced Enco-trained crews take charge of the installation.

The 18-page Enco Bulletin, BW44, shows how engineers throughout industry have gotten higher boiler efficiency and increased steam production through the use of Enco Streamline Baffles. Why not write for your FREE copy today?

The Engineer Company Produces:

ENCO OIL BURNERS

ENCO FUEL OIL PUMPING AND HEATING UNITS

ENCO AUTOMATIC OIL-ELECTRIC IGNITION SYSTEM

ENCO AUTOMATIC COMBUSTION CONTROL

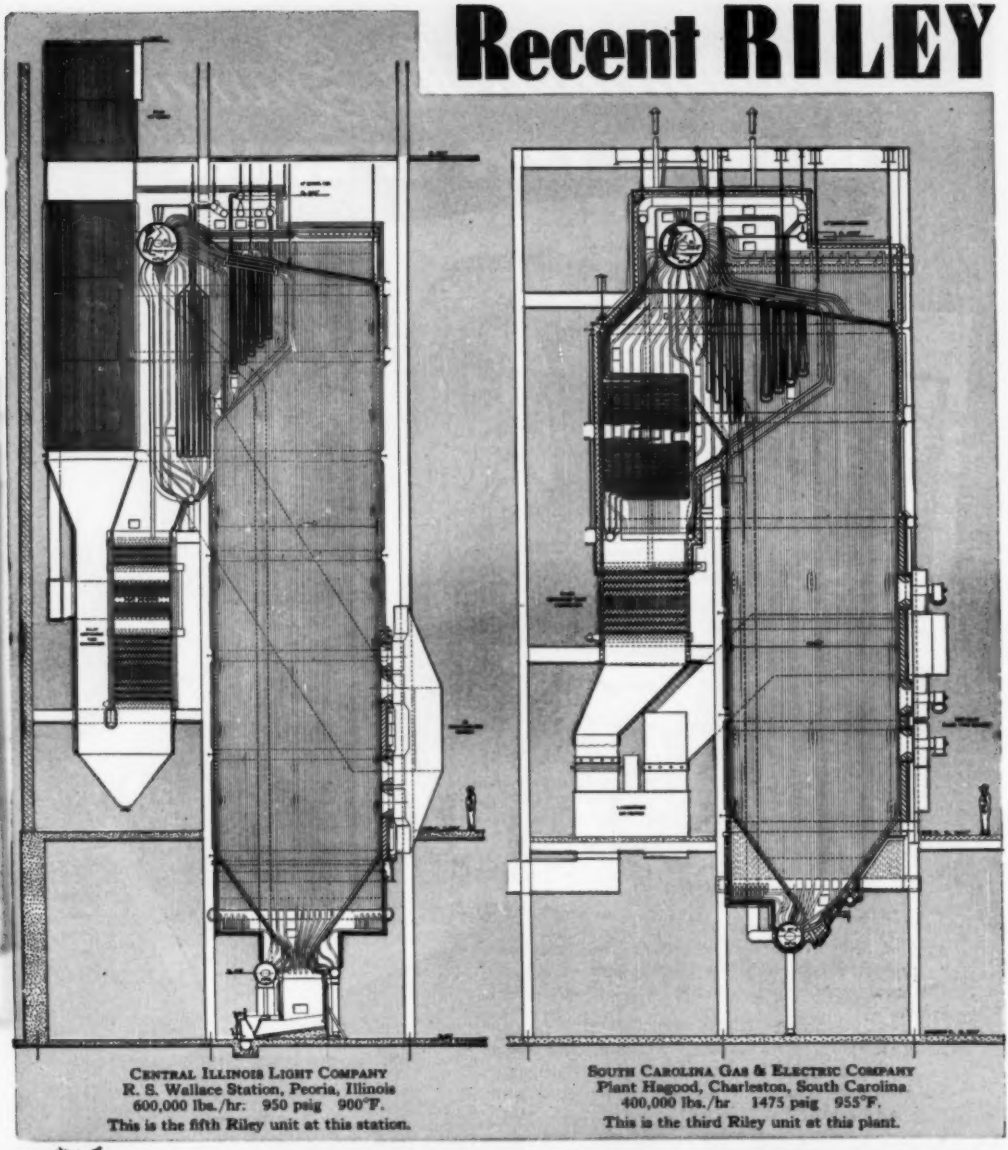
THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

Canadian Representative:

Rock Utilities Ltd., 80 Jean Talon St. W., Montreal, P. Q.

Recent RILEY



CENTRAL ILLINOIS LIGHT COMPANY
R. S. Wallace Station, Peoria, Illinois
600,000 lbs./hr. 950 psig 900°F.
This is the fifth Riley unit at this station.

SOUTH CAROLINA GAS & ELECTRIC COMPANY
Plant Hagood, Charleston, South Carolina
400,000 lbs./hr 1475 psig 955°F.
This is the third Riley unit at this plant.

TRADE MARK Rx REGISTERED

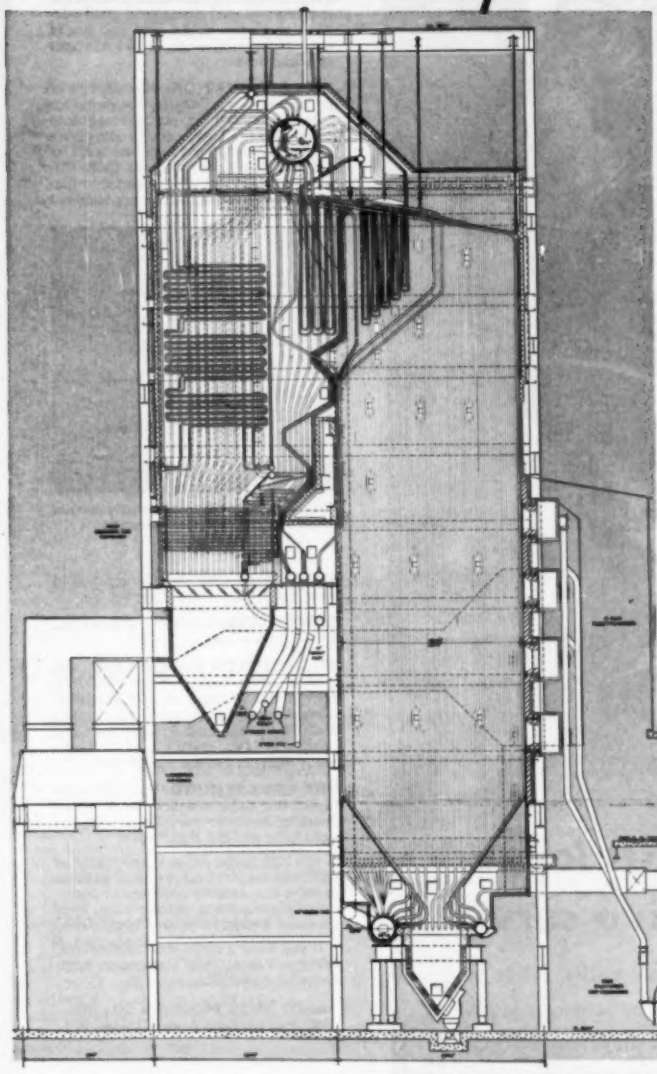
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Charlotte · Atlanta · New Orleans · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS

Public Utility Installations



Houston Lighting & Power Company

Deepwater Station	1—1,300,000 lbs./hr.
West Junction Station	3— 825,000 lbs./hr.
West Junction Station	2— 400,000 lbs./hr.
Greens Bayou Station	2— 675,000 lbs./hr.
Gable Street Station	1— 350,000 lbs./hr.
Gable Street Station	1— 250,000 lbs./hr.
Gable Street Station	1— 140,000 lbs./hr.

The Potomac Edison Company

Albright Station	1— 700,000 lbs./hr.

Utah Power & Light Company

Hale Station	1— 450,000 lbs./hr
Gadsby Station	1— 620,000 lbs./hr.
Gadsby Station	1— 575,000 lbs./hr.

Iowa-Illinois Gas & Electric Company

Riverside Station	3— 250,000 lbs./hr.
Moline Station	1— 250,000 lbs./hr.
Moline Station	2— 300,000 lbs./hr.

Iowa Electric Light & Power Company

Marshalltown Station	2— 300,000 lbs./hr.
Boone Station	1— 275,000 lbs./hr.

Monongahela Power Company

Albright Station	1— 700,000 lbs./hr.

Northern States Power Company

Granite Falls Station	1— 385,000 lbs./hr.

Public Service Company of Indiana

Edwardsport Station	3— 400,000 lbs./hr.
Noblesville Station	3— 300,000 lbs./hr.
Dresser Station	1— 300,000 lbs./hr.

South Carolina Gas & Electric Company

Plant Hagood	1— 400,000 lbs./hr.
Plant Hagood	2— 230,000 lbs./hr.

Central Illinois Light Company

R. S. Wallace Station	1— 600,000 lbs./hr.
R. S. Wallace Station	4— 300,000 lbs./hr.

Gulf Power Company

Pensacola Station	1— 325,000 lbs./hr.
Pensacola Station	2— 230,000 lbs./hr.

City of Los Angeles

Harbor Steam Station	3— 825,000 lbs./hr.
Harbor Steam Station	3— 675,000 lbs./hr.

Southwestern Gas & Electric Company

Cherokee—Texas	1— 630,000 lbs./hr.

Arkansas Power & Light Company

Cecil Lynch Station	1— 650,000 lbs./hr.

Utah Power & Light Company
Gadsby Station
Salt Lake City, Utah

575,000 lbs./hr. 1700 psig
1000°F. Reheat 1000°F.

This is the second Riley unit at this station. Utah Power & Light Co. have ordered five Riley units.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

ALOYCO No. 111-A gate valve for 150 pounds service is made in a wide range of analyses to specification and regularly stocked in popular alloys.

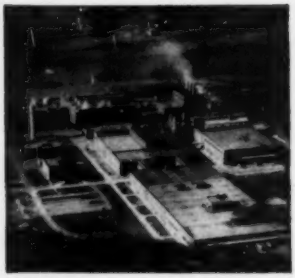
Lasts longer in corrosive service

This bolted bonnet type gate valve, made to specification, provides the three basic advantages of all ALOYCO valves . . . (1) special engineering for severe corrosive service through (2) extensive metallurgical research and (3) production of high alloy valves exclusively.

Celanese efficiently handles hot and cold acids with ALOYCO valves

THE CORROSIVES: Cold, hot and boiling vapor glacial acetic acid; cold mixtures of glacial acetic acid and acetic anhydride; cold, weak (30%) mixtures of acetic acid.

THE APPLICATION: Manufacture of cellulose acetate flake (raw material for many plastics) from purified cellulose in combination with acetic anhydride and acetic acid, with sulfuric acid as catalyst. (Cellulose acetate flake dissolved in acetone is extruded into filament yarn and staple fiber for textiles.)



This Celanese plant enjoys lower valve cost and longer valve life with ALOYCO valves.

THE PLACE: Celanese Corporation of America, Celco plant, Narrows, Va.

THE VALVES: ALOYCO 18-8SMo No. 111-A gate valves.

THE RESULTS: Former acid-resistant bronze valves with stainless steel trim proved unsatisfactory on cold acid mixtures. On the other hand, the original ALOYCO valves, installed when the plant opened in 1940, are still operating perfectly with only minor maintenance.

THE BACKGROUND: No other valve maker has such extensive facilities for meeting corrosive conditions with the right alloy and the right valve.

ALOYCO is the *largest specialist* in corrosion-resistant valves, applies them to solve successfully problems of corrosion, contamination, discoloration, temperature extremes, proper application.

If you have a problem of this nature, address it to ALOYCO's corrosion engineers for a profitable solution.

ALLOY STEEL PRODUCTS CO., INC.
1985 West Elizabeth Avenue, Linden, N. J.

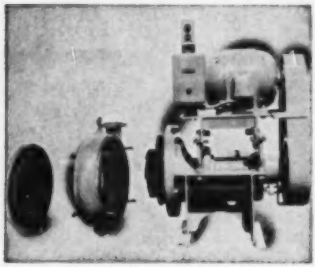
Longer Lasting
ALOYCO VALVES
1st in Corrosive Service

New equipment and developments

(Continued from page 22)

20—Pump handles solids and acids

For handling solids and acids, The Galigher Co. has announced a pump, the Vacseal, which is said to operate



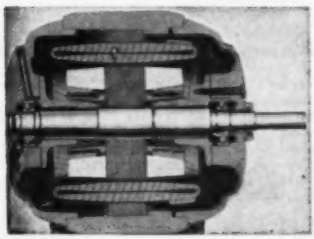
on a vacuum-seal principle which prevents fluids or entrained solids from being forced into the gland. Units are available in 2, 3, 4, 6 and 8 in. sizes with rubber lined or all-metal construction. Capacities are to 3000 gpm. The rubber lined pumps are said to be suitable for heads to 100 ft, and the all-metal units are for heads to 150 ft. A bulletin gives full details.

21—Conveyer belt is rip-proof

New York Belting & Packing Co. has developed a conveyer belt said to be virtually rip-proof. It was designed particularly for use where conveyer belts are subject to severe ripping or tearing action by foreign objects, such as in mining, quarrying or foundry operations. The unusual properties are reported to result from multiple strands of high tensile steel wires imbedded at 3 ft intervals in the carcass.

22—Totally-enclosed motor is self-cooling

For services where dampness, dust, fire hazards and corrosive fumes are prevalent, U. S. Electrical Motors Inc. has designed a totally-enclosed motor, the type SS. The construction provides for self-cooling. It has been approved by Underwriters' Laboratories for explosion-proof service in hazardous locations. Units range from ⅓ to 2 hp, with fan-cooled models to 75 hp. Many advantages are described in a bulletin.



23—Portable pH meter uses three batteries

Three radio batteries used in the model 125 portable pH meter, developed by Photovolt Corp., are said to provide 2000 hr of operation. Advan-

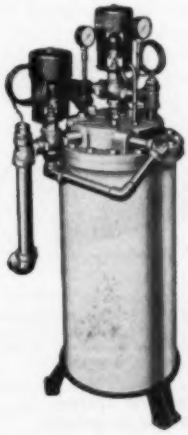
tages claimed for this unit include low cost, an accuracy of 0.03 pH, and simplicity of operation and maintenance. A data sheet is available.

TO REQUEST ADDITIONAL FREE DATA

Insert "key" numbers on return post card found on page 123. Our Reader's Service Department will handle your request promptly

24—Water heater uses steam

Improvements incorporated in a steam-heated water heater, manufactured by The Coe Mfg. Co., are said to provide greater safety and increased temperature control. The unit delivers



water at 120 F, and if desired, secondary water at 160 to 180 F. Available literature lists 17 sizes with capacities from 200 to 3000 gph.

25—Holder is used when resurfacing commutators

According to the manufacturer, The Martindale Electric Co., the type C holder has been developed to hold Commstones rigid and true for concen-

tric resurfacing of commutators and slip rings while running at normal speeds in their own bearings. Being only 3¼ in. wide, it fits into close quarters. It can be equipped with a 2 in. box for grinding commutators or slip rings from 1 to 3¼ in. wide, or with a stone holder and two Commstones for grinding bars up to 4¾ in. long.

26—Generator design eliminates brushes

Georator Corp. has announced an improved Nobrush electric generator which employs a permanent magnet construction to avoid the use of brushes. Units generate 400 c current at common voltages for single or three

phase service. Outputs range from 250 to 2500 va. Applications include use as a portable power unit or for operation of newer high frequency power tools. Units are available for direct or belt drive, or as motor or engine generator sets. A data sheet is available.

27—Oxygen analyzer is for combustion applications

Designed for combustion applications, the F-3 oxygen analyzer developed by Arnold O. Beckman, Inc. indicates oxygen content of flue or process gas automatically. The instrument, which utilizes the paramagnetic prop-

(Continued on page 28)

New equipment and developments

(Continued from page 27)

erty of oxygen, features simplified operation and low maintenance. Accuracy is said to be within 1 per cent of full scale for spans of 5 per cent and greater. Several ranges are available.

28—Portable heating unit for preheating studs

To preheat large studs such as those used to clamp together large castings on hydraulic presses, Edwin L. Wiegand Co. has designed a heavy-duty, portable electric heating unit. In use, the unit is inserted in a hole drilled through the stud. The nut is tightened

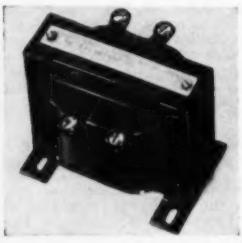
while the stud is hot, thus resulting in a tight fit when cooled. Standard lengths range from 10 to 70 in. with outside diameters of ½ to 1 in. Capacities are 2 to 12 kw.

29—Five basic hose types replace eighteen

Thermoid Co. has consolidated its molded hose line from 18 basic types to five, color-coded for identification. Improvements, including tubes and covers of both natural and synthetic rubber and the use of high strength rayon braids, are said to offer increased versatility for each basic type. A data sheet lists applications.

30—Transformers provide improved regulation

Three additional sizes have been added to a line of control circuit transformers manufactured by Hevi Duty Electric Co. They are rated 30, 50 and 150 va, with primary voltage of 230/460 and secondary voltage of 115, to be used on 50 or 60 c circuits. Previous sizes were from 250 va to 10 kva. An important feature, according to an available bulletin, is better voltage regulation in low power factor circuits when momentary overload caused by high inrush current is encountered.



31—Selenium rectifier welders have many advantages

All the advantages of a-c transformer type welders are combined with those of d-c motor generator types in a selenium rectifier d-c welder featuring a magnetic amplifier principle, according to the manufacturer, Miller Electric Manufacturing Co. Electric

control makes remote operation possible. Models ranging from light applications to heavy duty production work are available.

TO REQUEST ADDITIONAL FREE DATA

Insert "key" numbers on return post card found on page 123. Our Reader's Service Department will handle your request promptly

32—Unit provides accurate air velocity measurement

Highest accuracy in measurement of air velocity, coupled with instantaneous, direct readings are provided by the Precision Air-Meter, according to the manufacturer, Hastings Instrument Co. Many field and permanent applications are listed, including use with

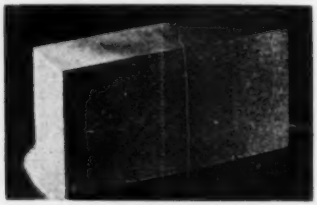
process control relay systems. Dual scale ranges provide air velocity measurement of 0 to 400 and 400 to 6000 fpm. Operation is on 110 v, 60 c current. Literature is available.

33—Television system features simplicity

Closed circuit industrial television is being marketed by RCA Victor Div. of Radio Corporation of America. Equipment consists of two units: a camera about the size of a 16 mm movie camera and a combination monitor, power supply and control unit housed in a small portable case. The camera is reported to contain only three tubes. Power supply is 115 v, 60 c, with 50 c equipment available on special order. Power consumption is 230 w.

34—Insulating brick increases furnace efficiency

Insulating firebrick made of vermiculite and clay binders has been developed by Zonolite Co. Designed primarily as back-up insulation for refractory brick at temperatures to 1800 F, it is said to increase furnace efficiency and



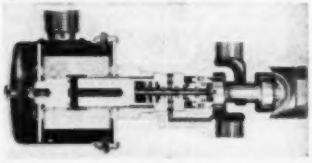
help reduce operating costs. Tests show that the bricks have high resistance to cracking caused by impact and thermal shock, good physical and chemical stability within their temperature range, and are easily cut.

35—Coating is developed for severe corrosive conditions

Proco liquid neoprene coating can be brushed, dipped or sprayed onto such surfaces as steel, concrete and wood. According to the manufacturer, Connecticut Coatings Co., it was developed for applications where acid or corrosive fumes create problems too rigorous for usual types of coatings. Described as an air cure protective coating, it is said to provide all the advantages of Neoprene. Elaborate surface preparation is not required.

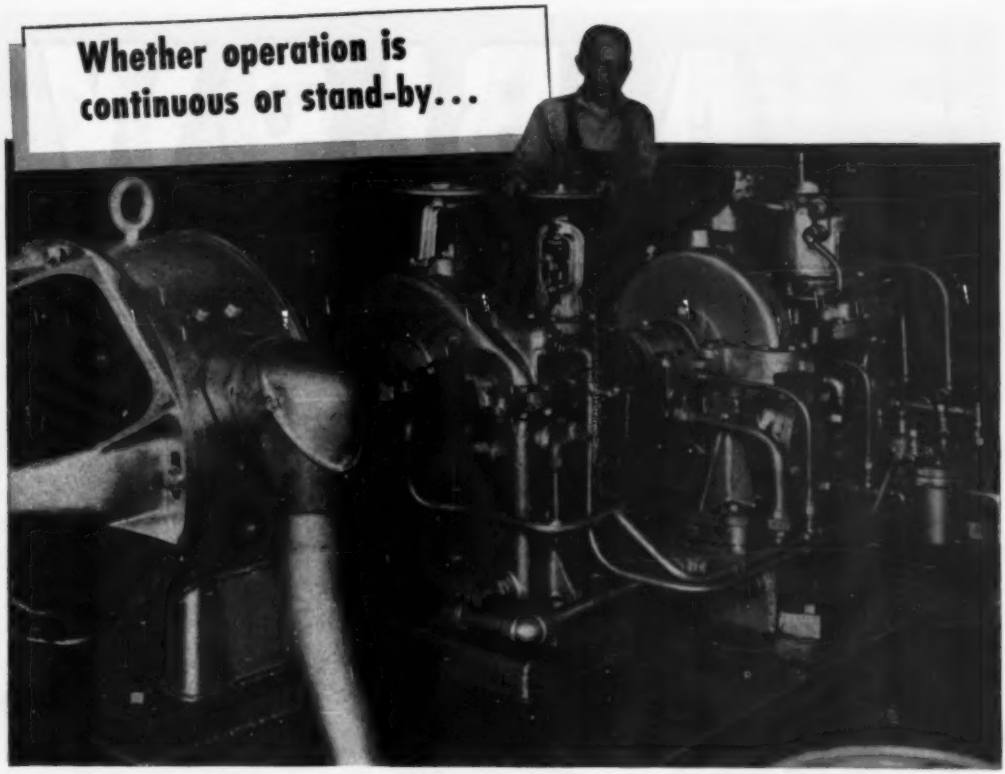
36—Solenoid valve features compact design

Crescent Valve Co. has developed a compact 3-way solenoid valve, model 1034, to control any light fluid medium



such as air, water and light oils. This solenoid controlled, pilot operated unit provides a pressure range from 20 to 500 psi for either normally open or normally closed service. Valve bodies with threaded connections for port sizes of ⅛, ¼, ½ and ¾ in. are available. Solenoid coils are rated for continuous duty and for standard a-c and d-c voltage.

(Continued on page 32)



TYPE E turbines can handle it!

In the powerhouse of William F. Schrafft & Sons, makers of the famous "Schrafft's Chocolates," Charlestown, Massachusetts, the Type E turbine is used on a 40-kw, d-c exciter. The turbine exciter is supplementary to a motor-driven exciter for one 750- and two 1000-kw Westinghouse Turbine-Generators.

Of this installation, both the Chief Engineer and the Chief Power Plant Operating Engineer stated, "We are impressed by the design, appearance, and smooth-running qualities of the Type E turbine, and also the unique design of the oil-relay governor and forced-feed lubrication which the Type E provides." This all-Westinghouse end of Schrafft's power plant includes a new 1000-kw Westinghouse Geared Turbine-Generator, served by existing Westinghouse switchboard equipment and motor-generator sets.

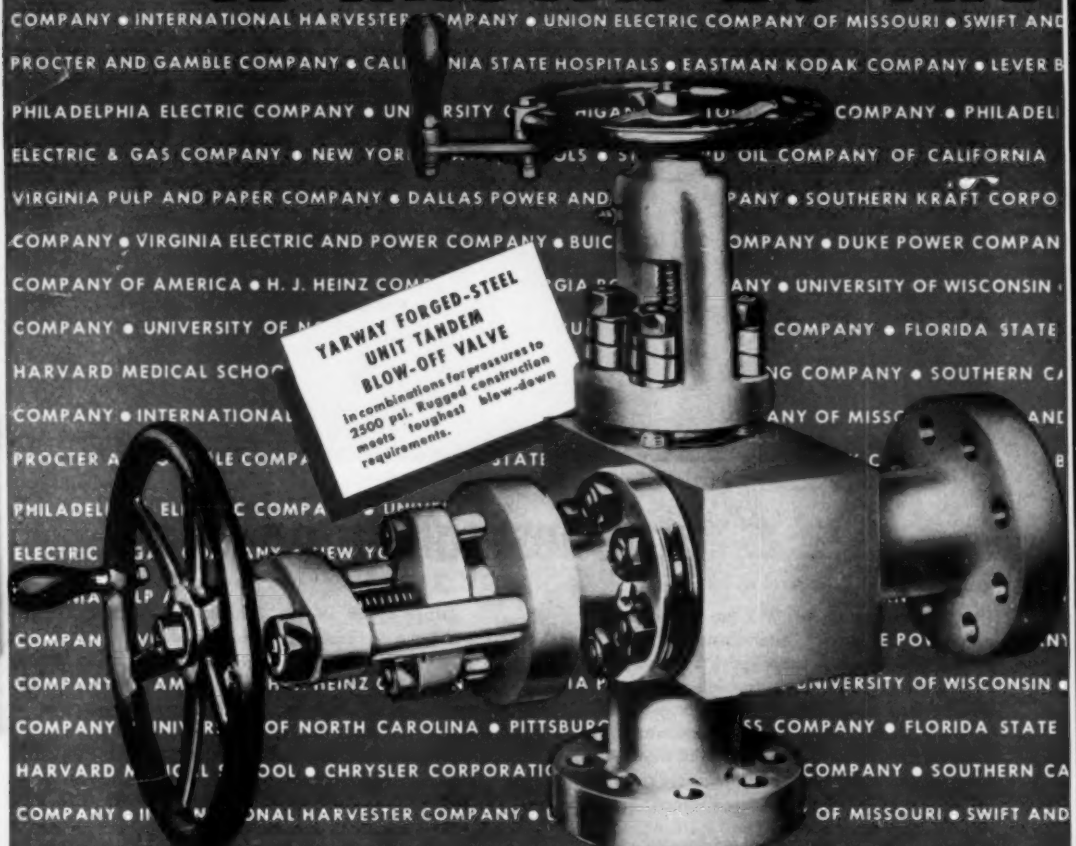
Here's the general-purpose turbine that meets the many stern demands of modern industry. Regardless of operating conditions, the Type E is built to give dependable, trouble-free, economical performance for long periods of continuous operation . . . or instant operation when used as a stand-by drive.

Other types in the complete Westinghouse general-purpose turbine line include heavy-duty and multi-stage units for applications requiring higher temperatures and pressures, higher speeds, greater horsepower, extraction for process applications or higher efficiency than can be obtained with single-stage machines. Get the facts on this broad turbine line . . . call your nearby Westinghouse Office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-30340

YOU CAN BE SURE...IF IT'S
Westinghouse
TYPE E Turbines

A BLOW-

IS KNOWN BY THE


YARWAY FORGED-STEEL
UNIT TANDEM
BLOW-OFF VALVE
In combinations for pressures to 2500 psi. Rugged construction meets toughest blow-down requirements.

YARWAY

HIA PUBLIC SCHOOLS • PACIFIC GAS & ELECTRIC COMPANY • IOWA STATE COLLEGE • PUBLIC SERVICE
BOSTO S AN LI PA JN EST
ATIO E ANY) IC N ER TOR
• E. I. MPANY AN C NY UM
R. J. REYNOLDS TOBACCO COMPANY • CARNEGIE INSTITUTE OF TECHNOLOGY • HUMBLE OIL AND REFINING
HOSP M NG NY • SITY Y •
LIFO IO RPO ATI N OF ERI N O ER NO GHT
COMPANY • FLORIDA POWER COMPANY • ARMOUR AND COMPANY • UNIVERSITY OF PENNSYLVANIA •

OFF VALVE

BOILERS IT PROTECTS

When buying blow-off valves, weigh the significance of these two facts:

More than 15,000 boiler plants in the United States and other countries are equipped with Yarway Blow-Off Valves... Some of them for nearly 40 years. *Among high pressure plants, 4 out of every 5 in the United States are Yarway-equipped.*

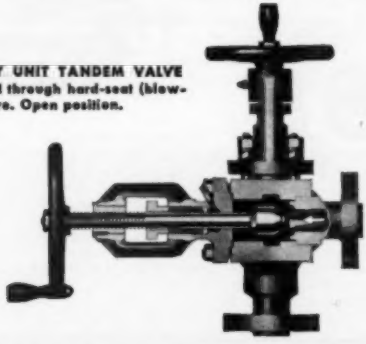
Design, metallurgy, workmanship and service are the reasons. It was Yarway that brought out the famous Seatless Valve, teamed it with a stellited hard-seat valve in a common forged-steel body to make the popular Unit Tandem. Yarway has also made available metallurgical improvements to withstand the chemical reactions of acid wash as well as the mechanical wear of boiler blow-down.

Yarway continues to pioneer and improve blow-off valves and blow-off valve service for both high and low pressure applications.

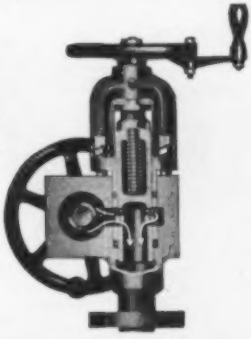
On new boilers, replacements or modernization, make sure you specify Yarway Blow-Off Valves. Any boiler manufacturer will supply them on your specification.

Bulletin B-424 gives you the full story on pressures to 400 psi. Bulletin B-433 for higher pressures. Both are free. Write...

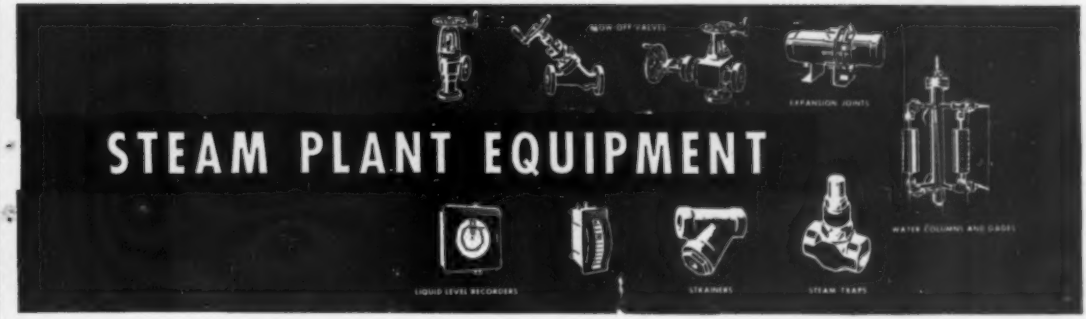
YARNALL-WARING COMPANY, 109 Mermaid Ave., Philadelphia 18, Pa.



YARWAY UNIT TANDEM VALVE sectioned through hard-seat (blowing) valve. Open position.



YARWAY UNIT TANDEM VALVE sectioned through seatless (sealing) valve. Open position.



New equipment and developments

(Continued from page 28)

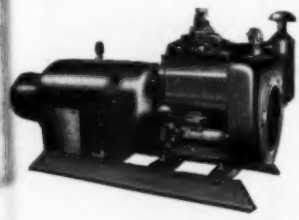
37—Packing rings withstand wide temperature range

V-packing rings molded from pure Teflon are being manufactured by Flexrock Co., Packing Div. Two de-

signs, one for low pressure and one for high pressure, up to 5000 psi, are available in all sizes. Both types can be used within a range of -90 to 500 F.

38—Stand-by generator has air cooled engine

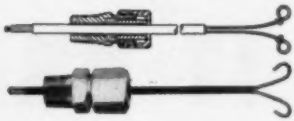
For emergency stand-by service, an electric generating plant, manufactured by Universal Motor Co., features a 4 cylinder air cooled gasoline engine. It is available with electric starting or with controls for automatic starting



when regular power fails. Capacity is 10 kw for single or three phase service in standard or special voltages.

40—Packing gland seals entry of small lines

For sealing the entry of small dial-type thermometers, thermocouple wells, pilot tubes, static pressure probes, and insulated electric lines, Conax Corp. has designed a midget packing gland—model MPG. Stainless steel is used for



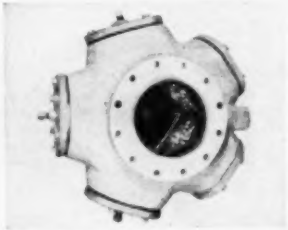
resistance to corrosion. Sizes for tubes of 3/32, 1/8 and 3/16 in. diam are available from stock.

TO REQUEST ADDITIONAL FREE DATA

Insert "key" numbers on return post card found on page 123. Our Reader's Service Department will handle your request promptly

41—Check valve is for compressor discharge lines

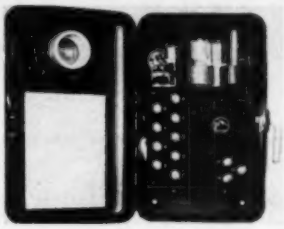
Compressor check valves for discharge lines above 6 in. diam have been added to the line of Airchek valves manufactured by Pennsylvania Pump and Compressor Co. The units are said to have exceptional ability to dampen pipe-



line pulsation. Construction is for quick servicing. Sizes are available for discharge lines of 8, 10 and 12 in. A 2-page bulletin sheet is available.

42—Photoelectric control has many applications

Photoelectric controls adaptable to a wide variety of industrial applications are being offered by Photoswitch Inc. Known as series 20 and 21, they have been designed to provide continuous, instantaneous, free operation under exacting ambient operating conditions. They are said to withstand high temperatures, humidity and vibration. Op-



eration is on 115 or 230 v, 50 or 60 c supply. Recommended applications and design features are described in available literature.

43—Air blow gun eliminates dust cloud

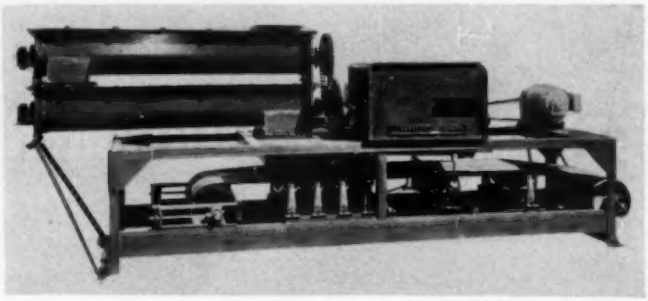
To eliminate the usual cloud of dust blown into an operator's face when the valve of an air blow gun is released,

Supreme Machined Products Co. has developed the Tu-Flo blow gun. The unit permits only a small volume of air during 90 per cent of the control button travel, however an immediate full blast can be obtained if desired. Units for ⅛, ¼ and ⅜ in. pipe thread connections are available. Many advantages are listed in a data sheet.

—End

39—Unit regulates feed of finely divided materials

Sintering Machinery Corp., Transportometer Div., has designed a feed regulating Transportoweigher for automatically and continuously conveying, weighing and maintaining pre-set rate of feed of any finely divided material. Accuracy of regulation is said to be 99.5 per cent or better, regardless of belt speed or tonnage variations. Units are available for a wide range of applications for installation on new or existing belt conveyers or between conveyers and processing equipment. Tonnage passing over a belt is recorded on a direct reading totalizer.



Industry Leaders Set the Pace with VU

Right down the line, in most every industry, you'll find the leading companies – as well as the smaller companies that may well be tomorrow's leaders – depending on C-E Vertical Unit Boilers for dependable, low-cost steam.

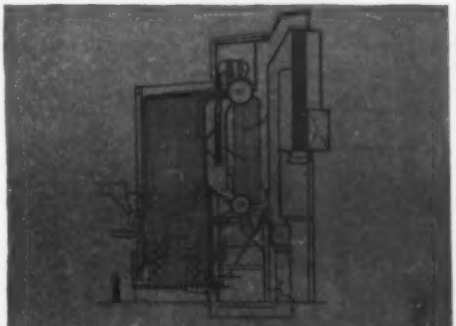
Take Pulp and Paper Mills for example. Few industries use more steam or have a larger stake in the economy and reliability of their steam generating equipment. The list below is just a sample of the nationally-known leaders in the pulp and paper field that have Vertical-Unit Boilers in service at one or more mills.

Only larger companies are listed because here, as in any industry, the buying decisions of big companies are especially significant. Such companies have the breadth of experience, the diversified operating conditions and the organization necessary to explore and evaluate the merits of the equipment they need.

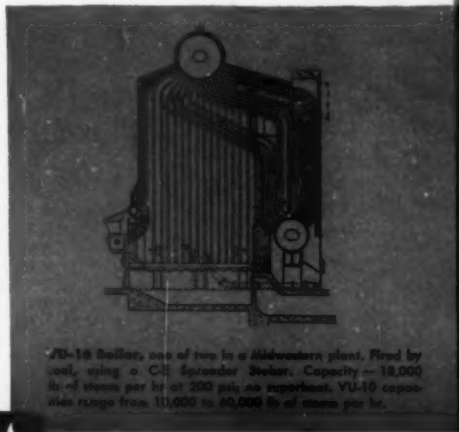
So, where you need boilers – in capacities from 10,000 to 350,000 pounds of steam per hour – take a tip from the leaders. Discover – as they have – the advanced design . . . sound construction . . . proved reliability of C-E Vertical-Unit Boilers.

Leading Pulp and Paper Mills that have Purchased VU Units for One or more Plants

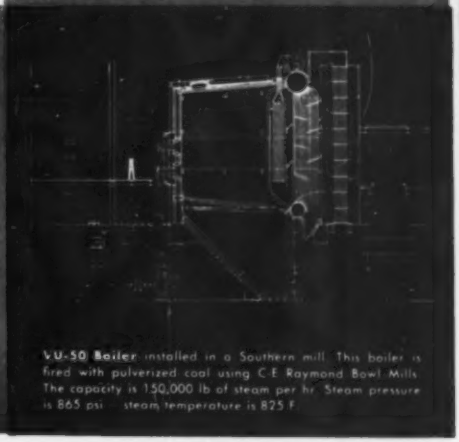
The Brown Company
Chesapeake Corporation
Container Corp. of America
Fraser Companies, Ltd.
Robert Gair Company, Inc.
International Paper Company
Kimberly-Clark Corporation
Macon Kraft Corporation
Marathon Paper Mills of Canada, Ltd.
National Container Corporation
St. Regis Paper Company
Scott Paper Company
S. D. Warren Company
Weyerhauser Timber Company



VU-90 Boiler – This unit, one of two duplicates, is installed at a West Coast mill. It is designed to burn hogged wood on a high-set spreader stoker. Capacity – 150,000 lb of steam per hr; operating pressure – 370 psig steam temperature 575 F.



VU-10 Boiler, one of two in a Midwestern plant. Fired by coal, using a C-E Spreader Stoker. Capacity – 18,000 lb of steam per hr at 200 psig no superheat. VU-10 capacities range from 10,000 to 60,000 lb of steam per hr.



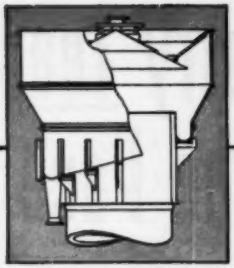
VU-50 Boiler installed in a Southern mill. This boiler is fired with pulverized coal using C-E Raymond Bowl Mills. The capacity is 150,000 lb of steam per hr. Steam pressure is 865 psi – steam temperature is 825 F.

C-E

COMBUSTION ENGINEERING–SUPERHEATER, INC.

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

B-612A



SCHNEIBLE

CUPOLA COLLECTORS

WASH OUT FOUNDRY FLY-ASH AND FUMES TO CUT BUILDING MAINTENANCE COSTS

Here's a modern automotive foundry with 8 Schneible Cupola Collectors on guard against corrosion and deterioration. Fly-ash and fumes cannot play havoc with roofs, gutters, stacks or machinery. Building maintenance is kept at a minimum.

These Schneible Collectors effectively wash out the elements that cause nuisance and sluice them away to dewatering and recirculating tanks for easy removal

Economy of operation and efficiency are outstanding features of these Cupola Collectors. Water conservation is assured because the dewatering tanks are designed to purge and recirculate the same water continuously. There are no moving parts that require maintenance and the water distribution head cannot clog.

Your local Schneible representative has further information or write direct for bulletin No. 449.

CLAUDE B. SCHNEIBLE COMPANY

P. O. Box 81, North End Station
Detroit 2, Michigan

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE DIRECTORY.

B.F.Goodrich GROMMET BELTS AT WORK

Mechanical railroad "detective" with X-ray eyes that can "see" right through steel helps prevent train accidents.

"Track walker" sees through steel

That car inspects more railroad track in a day than a man on foot could cover in a week. Delicate electrical equipment detects hidden flaws a man could never see. Two big generators supply the electricity, but the belts needed to run them caused trouble. Stretch or slip of the belts affected the generators, and that distorted the testing equipment. Ordinary V belts stretched badly; replacement was frequent and costly. On the next page you'll see how an entirely different kind of belt solved the problem.

Track walker (continued)

Belts that slipped and stretched set off a chain reaction that spoiled the vision of X-ray eyes in the Sperry Detector Car.

THE problem described on the preceding page was solved when B. F. Goodrich grommet V belts were installed. Grommet belts are more flexible, don't slip or stretch as much as ordinary belts. Now BFG grommet belts are giving 3 times the service of other belts, saving belt costs, and cutting repair and maintenance time by 60 per cent. Here's the reason grommet belts last longer, serve better, save money.

20 to 50% Longer Life

Patented grommet V belts by B. F. Goodrich represent the only basic improvement since invention of the V belt. Belts last 20 to 50% longer, depending on service. (The more severe

the service the greater the increase over ordinary belts.)

What is a grommet?

A grommet is like a giant cable except that it's endless—a cord loop built up by winding heavy cord on itself. There is no overlapping cord *section* as in all ordinary belts. Most belt failures occur in these sections where cords overlap!

All Cords Put to Work

Each grommet and every part of a grommet carries its share of the load. In ordinary belts under high tension the center cords "dish" because tension is greater near the driving faces. Dished cords are doing less work, not pulling their share. Grommet V belts have no center cords, there is no dishing—therefore much more strength in proportion to cord volume.

Better Grip, Less Slip

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor.

They Cost No More

You save belt costs because belts last longer, reduce production costs because machines keep running with fewer interruptions, reduce maintenance costs because they need less attention, yet cost not one cent more than others. Grommet belts are made in C, D and E sections. They are patented by B. F. Goodrich. No other V belt is a grommet belt (U. S. Patent Number 2,233,294).

Highway robber

When this drive stops, rock needed for highway construction doesn't get crushed, new roads don't get built on schedule. In addition to running 9 hours a day, 6 days a week, the belts that drive the rock crusher are exposed to dampness, oil and sharp grit. Previous belts suffered from shock loads, wore out fast. The company, Valley Limestone & Gravel, Inc., Farmington, Iowa, tried other V belts, even flat belts, but mechanical trouble and production hold-ups continued. Then a B. F. Goodrich man suggested grommet V belts to stand the jerks and hard pulls. The B. F. Goodrich grommet V belts shown here have been in service 2 years, production has been increased 25%, labor and maintenance time has been reduced.

Jolting, crunching action of rock crusher used to cause production "hold-ups".

B.F.Goodrich GROMMET BELTS AT WORK

Softened up for a beating

It's wash day round-the-clock, 6 days a week in this plant. Here rags are soaked and shredded before being beaten to a pulp and used for making paper. Belts are used to drive the washer, but it's rough service. Starting it causes shock loads, and the long hours would be a strain on any driving mechanism. Something exceptional was needed, so B. F. Goodrich grommet V belts were installed. They have done a better job of running the machine than belts previously used, and stood the shock and strain for 8½ years.

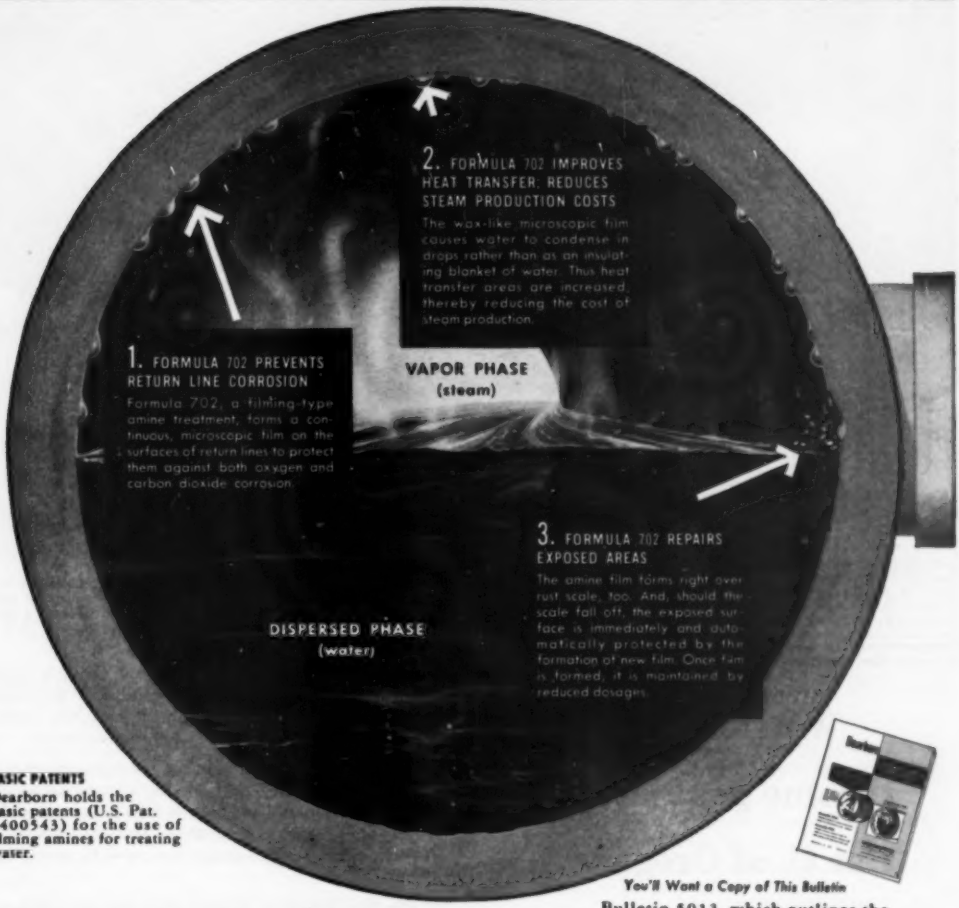
Every day is wash day at Millers Falls Paper Company, Millers Falls, Mass.

These typical examples (see preceding pages) tell you why B. F. Goodrich grommet belts are superior to ordinary V belts — prove they last 20 to 50% longer—yet cost no more.

Grommet V Belts BY
B.F.Goodrich
FIRST IN RUBBER

The B. F. Goodrich Company, Industrial Products Division, Akron, Ohio

3 reasons why every power engineer should know about Dearborn Formula 702


2. FORMULA 702 IMPROVES HEAT TRANSFER; REDUCES STEAM PRODUCTION COSTS
The wax-like microscopic film causes water to condense in drops rather than as an insulating blanket of water. Thus heat transfer areas are increased, thereby reducing the cost of steam production.
1. FORMULA 702 PREVENTS RETURN LINE CORROSION
Formula 702, a filming-type amine treatment, forms a continuous, microscopic film on the surfaces of return lines to protect them against both oxygen and carbon dioxide corrosion.
VAPOR PHASE (steam)
3. FORMULA 702 REPAIRS EXPOSED AREAS
The amine film forms right over rust scale, too. And, should the scale fall off, the exposed surface is immediately and automatically protected by the formation of new film. Once film is formed, it is maintained by reduced dosages.
DISPERSED PHASE (water)

BASIC PATENTS
Dearborn holds the basic patents (U.S. Pat. 2400543) for the use of filming amines for treating water.

You'll Want a Copy of This Bulletin

Bulletin 5013, which outlines the causes of return line corrosion and the method of cure with Formula 702, will be sent on request.

This cross-section of a return line, showing how *Dearborn Formula 702,* which is fed directly into the boiler, works to eliminate costly corrosion, reduce maintenance, avoid shutdowns and protect valuable equipment. If the pH value of your steam condensate is excessively low, it will pay you to discuss Formula 702 with your Dearborn Engineer.

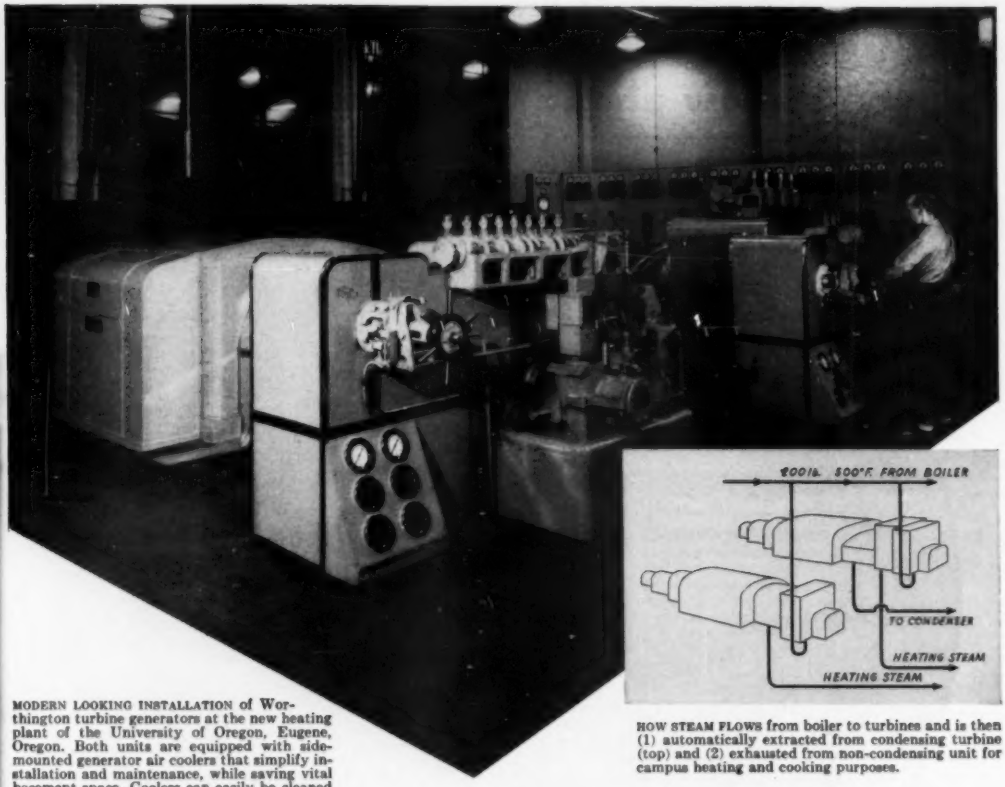
DEARBORN CHEMICAL COMPANY • Merchandise Mart Plaza • Chicago 54, Illinois

Dearborn Chemical Company Dept. IHP
Merchandise Mart Plaza
Chicago 54, Ill.

( ) Send a copy of Bulletin 5013
( ) Have a Dearborn Engineer call

Name.....
Position.....
Company.....
Address.....
City.....*Zone*.....*State*.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES



MODERN LOOKING INSTALLATION of Worthington turbine generators at the new heating plant of the University of Oregon, Eugene, Oregon. Both units are equipped with side-mounted generator air coolers that simplify installation and maintenance, while saving vital basement space. Coolers can easily be cleaned during turbine operation.

HOW STEAM FLOWS from boiler to turbines and is then (1) automatically extracted from condensing turbine (top) and (2) exhausted from non-condensing unit for campus heating and cooking purposes.

Worthington turbine generators at U. of Oregon designed for operating flexibility and appearance

When the University of Oregon built the new heating plant in 1951, the plans included installation of two turbine generators which would supply all the school's present and anticipated electrical and steam requirements.

But the university had another requirement—one not uncommon these days—that the installation be as clean and as modern looking as possible. One look at the above photograph and flow diagram shows that they got both in the Worthington turbine generators now in operation at the plant.

In the installation of Worthington turbine generators, the University of Oregon was assured of low-cost power and steam. It was also assured of the undivided responsibility that goes with turbine generators, designed, engineered, assembled and tested as complete units before shipment.

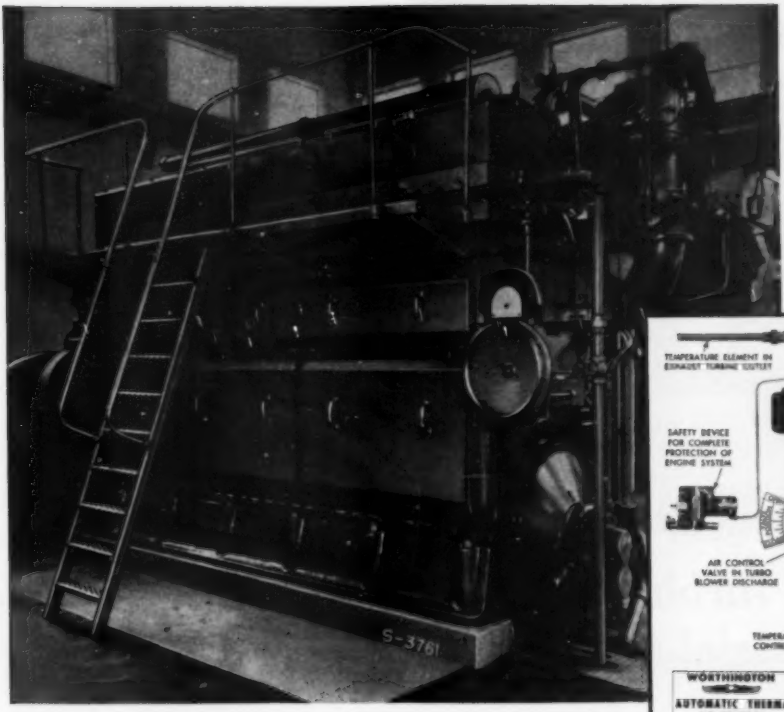
Sizes to 10,000 kw. Worthington Corporation, Steam Turbine Division, Wellsville, New York.

T-2-18

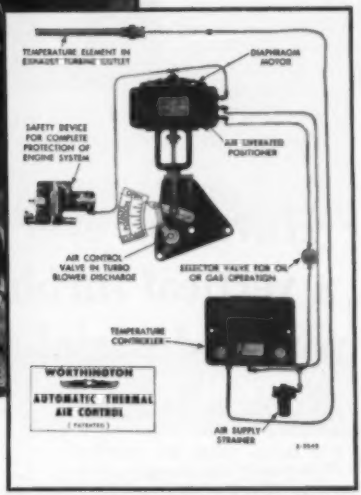
A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbine Generators



HANDLING INCREASING LOADS at the Vermillion, S. D., municipal power plant is this Worthington converted 840-kw dual fuel Diesel engine.


TEMPERATURE ELEMENT IN EXHAUST TURBINE OUTLET
DIAPHRAGM MOTOR
SAFETY DEVICE FOR COMPLETE PROTECTION OF ENGINE SYSTEM
AIR OPERATED POSITIONER
AIR CONTROL VALVE IN TURBO BLOWER DISCHARGE
SELECTOR VALVE FOR OIL OR GAS OPERATION
TEMPERATURE CONTROLLER
WORTHINGTON
AUTOMATIC THERMAL AIR CONTROL
AIR SUPPLY STRAINER

WORTHINGTON AUTOMATIC THERMAL AIR CONTROL supplies correct air-fuel ratio to the engine cylinders *at all times* and *in direct relation to all load changes.*

Vermillion, South Dakota, meets new power demands

In 1949, the City of Vermillion, South Dakota, was faced with the necessity of meeting increased electrical load requirements on its municipal power plant.

To solve this problem, Vermillion plant engineers decided to have their Worthington EE-6 Diesel engine, installed in 1937, converted to a more powerful unit.

Worthington engineered the change-over of the 500-kw naturally aspirated oil Diesel to an 840-kw supercharged dual fuel Diesel—an increase of 340 kw. Engine speed was raised from 327 to 360 rpm.

Now, after a year and a half of heavy-duty operation, the Worthington converted engine has proved to be the most efficient and reliable power producer in the Vermillion plant.

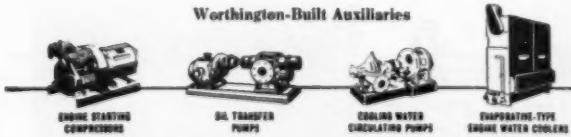
Four of the many exclusive Worthington features that insure top performance of Worthington dual fuel engines are:

1. Worthington automatic thermal air control for improved fuel economy.
2. Worthington dual plunger fuel pump for better, quieter combustion.
3. Worthington micro-metering gas valves—one for each cylinder—for equal cylinder loading and better speed regulation.
4. Worthington helical steel gear train for accurate and positive control of engine timing.

Worthington Corporation, Engine Division, Buffalo, New York.

B-2-3

Worthington-Built Auxiliaries



Economical Continuous Power—Diesels, Oil and Dual Fuel, and Spark-Ignition Gas Engines, from 150 to 2100 bhp.

WORTHINGTON
Engines

The Ten Leading Makes Of Vertical Turbine Pumps
√ Indicates Feature Is Standard

Standard Features	Worthington	Pump A	Pump B	Pump C	Pump D	Pump E	Pump F	Pump G	Pump H	Pump I
Seals above and below drain ports (oil-lubricated model)	√				√					
Wearing rings	√				√			√		
Enclosed impellers	√	√	√	√	√	√		√	√	√
Bronze bushings in bowl assembly	√		√	√	√	√		√	√	√
Flanged and bolted bowls on all sizes	√						√		√	√
Sand collars at both ends of bowl assembly (water-lubricated model)	√	√								
Grease-packed bottom bearing	√	√		√						
Choice of oil or water lubrication	√	√	√	√	√	√		√		

CHECK WORTHINGTON AGAINST THE REST
Only Worthington has all 8 vital design features as standard equipment.

Have you ever considered a vertical turbine pump for your industrial applications?

If you haven't, you may be missing a good bet.

For many years the vertical turbine pump was thought of as having only one application—deep well pumping. Recently, however, this efficient liquid handler has been given many other jobs, so that today we're not sticking our necks out when we say: it's an extremely *versatile* pump.

Let's take a look at the four inherent characteristics that make this pump really *versatile*:

1. THE DRIVE UNIT IS REMOTE AND SEPARATE FROM PUMPING ELEMENT. The pump always operates submerged. No priming. No expensive dry pits. No suction or NPSH problems.

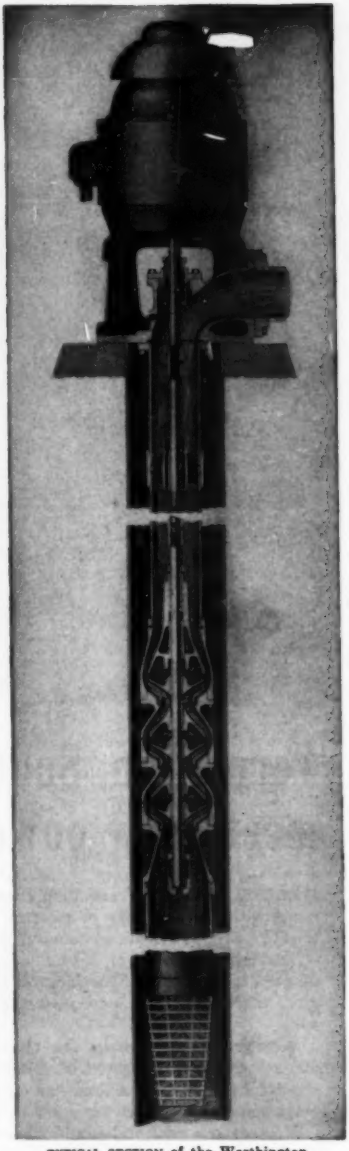
2. SPACE REQUIREMENTS AT A MINIMUM. Because of its vertical design, the vertical turbine pump takes less floor space than other types.

3. MECHANICAL AND HYDRAULIC FLEXIBILITY. Will operate with any type of drive. Discharge can be positioned to user requirements. Can be close coupled or several hundred feet long. Meets head and capacity requirements by varying the number of duplicate stages.

4. IT'S A SIMPLE MACHINE. Unidirectional thrust minimizes alignment problems. Easy maintenance, few moving parts, little friction, long life.

If you think a Worthington vertical turbine might be your answer to a pumping problem, or if you're not quite sure about it—we'd like to hear from you. Remember, Worthington, as the oldest manufacturer of pumping equipment, has the newest and broadest line of vertical turbine pumps.

Send complete data on your application mentioning capacities. Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Vertical Turbine Pump Division, Denver 16, Colorado; Succasunna, N. J.



TYPICAL SECTION of the Worthington water-lubricated vertical turbine pump that gives most efficient pumping performance at lowest possible cost.

D.1.11

The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON
Vertical Turbine Pumps

MORE POWER FOR GREECE

One of the four Detroit Rotograte Stokers of eight feeders each.

DETROIT ROTOGRATE STOKERS TO ISLAND OF EUBOEA

Four Detroit RotoGrate Stokers have been shipped to the Kingdom of Greece. Each Stoker will fire a 200,000 pound per hour capacity unit. Design is based on locally mined low-grade Lignite of 5,000 minimum BTU per pound and 35% moisture, and an ash fusing temperature of 2140° F with preheated air of 325° F. Steam pressure will be 925 psi, at 905° F. TT. The installation is at Aliveri Thermal-Electric Station, Island of Euboea. Design is by Burns and Roe, Inc., Engineers, New York, under supervision of Ebasco Services, Inc.

Detroit RotoGrate, an improved spreader stoker, will burn all grades of Bituminous Coal or Lignite with high thermal efficiency. Controlled turbulence permits higher burning rates per square foot of grate. Reinjection system is rugged, dependable.

Write for Detroit RotoGrate Bulletin.

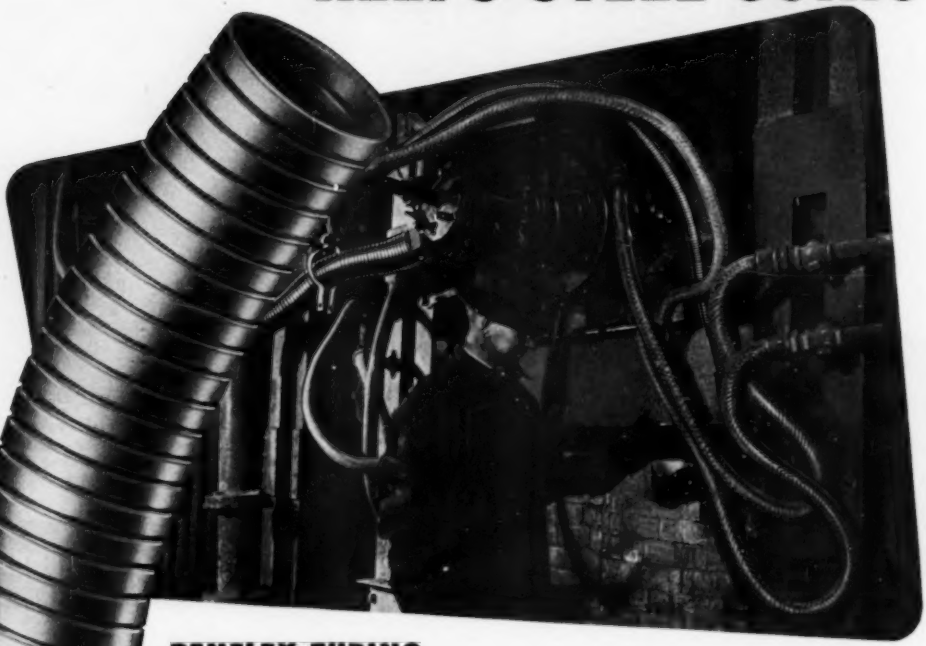
DETROIT STOKERS have been selected for plants around the world such as in:
ENGLAND • SCOTLAND
DENMARK • FRANCE
BELGIUM • ITALY • SPAIN
PORTUGAL • MOROCCO
GREECE • TURKEY
RUSSIA • POLAND • NIGERIA
UNION OF SOUTH AFRICA
INDIA • MALAYA • CHINA
AUSTRALIA • NEW ZEALAND • TASMANIA
PHILIPPINES • HAWAII
ALASKA • COLOMBIA
CHILE • BRAZIL

There is a Type and Size Detroit Stoker for Every Industrial Need

4842

DETROIT STOKER COMPANY

BEATS HEAT...STANDS WEAR... KEEPS STEEL GOING



PENFLEX TUBING PROVIDES FLEXIBILITY ON FUEL LINES... RUGGEDNESS... DURABILITY... RESISTANCE TO HEAT

Connecting fuel and cooling lines on an open hearth take a constant beating. High heats . . . excess wear . . . fatiguing expansion and contraction.

One of the nation's largest steel mills solved the problem with two Penflex products — Penflex interlocked, flexible metal tubing and Penflexweld corrugated tubing, with braided wire covering. "Flexineering" applied the right tubing most efficiently, and more consistent production resulted

Write for this helpful folder, "Flexineering" ...your guide for solving tubing problems.

Penflex flexible metal hose with couplings absorbs any pipe movement due to extreme temperatures and pressure changes. Provides outstanding safety and high uninterrupted flow of flammable materials. Leakproof, tough and flexible.

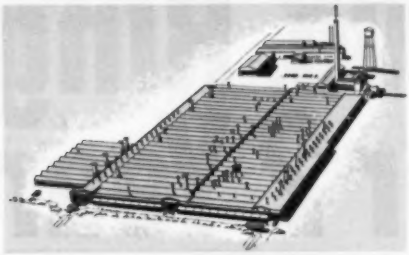
Penflex engineers can help you solve flexible tubing application problems. Penflex manufactures a complete line of four-wall, interlocking and seamless welded corrugated tubing . . from ⅛" I. D. and up . . . automatic barrel fillers, accessories and fittings.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7238 Powers Lane, Phila. 42, Pa.
Branch Sales Offices: **Boston • New York • Chicago • Houston • Cleveland • Los Angeles**

PENFLEX

HEART OF INDUSTRY'S LIFE LINES

BRIGGS MANUFACTURING



In this modern, efficiently operated plant, in Evansville, Indiana, Briggs Manufacturing Co. fabricates and assembles thousands of smartly styled, comfortably proportioned bodies for Chrysler's popular Plymouth car. STEAM—economically produced is essential to their great power and heat requirements.

Big Tecumseh Mine in Indiana—typical of Southern's extensive operations in Ohio, Western Kentucky, Indiana, and Illinois. Served by 11 major railroads.

SOUTHERN'S PRECISION PREPARED COAL—SPECIFICALLY APPLIED HELPS BRIGGS CONTROL STEAM AND PRODUCTION COSTS

Based on results from equipment analysis and burning tests in their boilers, Southern's recommendation for applying one of their wide selection of high quality industrial coals to Briggs' specific requirements, was approved . . . Efficient boiler performance, lower steam cost and substantial fuel economies are proving the soundness of the application.

This is typical of savings afforded many leading national industries.

Southern's service begins in your boiler room. It effects economies favorable to your over-all cost of operation—economies continuously assured through Southern's rigidly controlled program of production and preparation. Engineered to strictest industrial specification for quality and uniformity, coals are washed, precision sized, graded and laboratory tested daily. An annual capacity exceeding 10,000,000 tons provides dependable supply.

Contact your nearest Southern Office. Their recommendations for applying the right coal to your specific requirements will lead to more efficient burning performance, and lower steam and production costs.

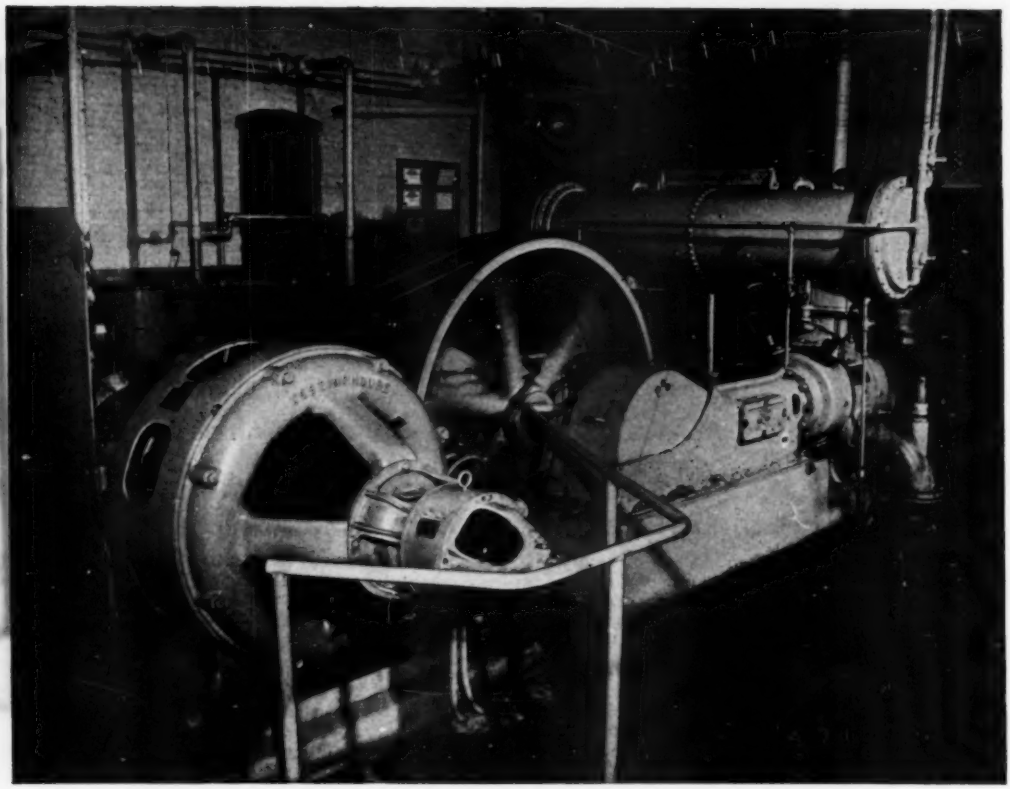
YOU CAN RELY ON SOUTHERN'S ENGINEERED INDUSTRIAL COALS

Southern Coal Company, Inc.

MEMBER OHIO MINOIS COAL RESEARCH INC.

GENERAL OFFICE: 333 North Michigan Avenue, Chicago 1, Illinois
OFFICES IN: Louisville, Memphis, Nashville, St. Louis
Sinclair Coal Company, Kansas City, Mo., Western Representative

"No Valve, Ring, or for Over 2 Years!"



The American Car and Foundry Company's huge plant at Huntington, West Virginia has been a user of Sinclair lubricants for over eighteen years. The results are of particular interest!

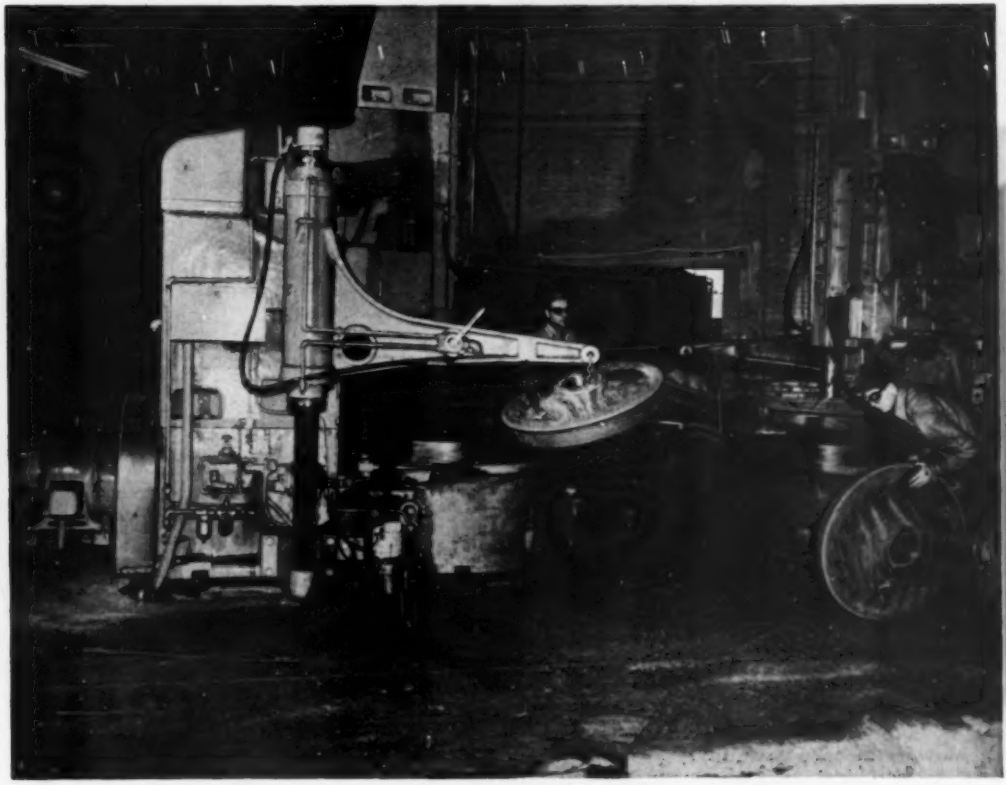
For example – the four compressors in the ACF plant are lubricated with Sinclair RUBILENE Medium. Proof of outstanding lubrication stamina is attested to by this service report: *"None of these compressors has required servicing of valves, rings, or bearings for over two years."*

Results speak volumes for this Sinclair Product. Why not investigate the advantages of RUBILENE Oils, available in *nine* viscosity grades? Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N.Y.

SINCLAIR RUBILENES®

Bearing Service

...SAYS THE AMERICAN CAR AND FOUNDRY COMPANY



"Rubilene has given Trouble-Free Service."

Further proof of RUBILENE quality is found in the operation of two Betts Heavy Duty Hydraulic Feed Car Wheel Bores. The American Car and Foundry Company says, "RUBILENE Oil Extra Light has given trouble-free service as the hydraulic fluid since these machines were put in service. No problem either, with chatter or sticking air hoists—RUBILENE Oil Medium in the air line lubricators does this job admirably."

for low maintenance costs

LIGHT

...but what a Lift!

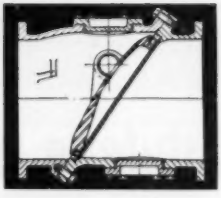
...that's the secret of this All-Time Low in Head Loss...

Take a close look at that Tilting Disc. See the special Aerofoil design that means light weight... and minimum resistance to flow in the open position.

Look again, and see how this Tilting Disc... pivoted just above center... is practically balanced, so is easily held open... and then cushions quietly to a drop-tight seat. This means no slamming under usual piping arrangements, no opening of pipe joints, no wear of valve parts.

And it means 65% to 85% less head-loss than with regular swing-type check valves. *Send for proof*... check the certified flow charts in Chapman's Bulletin No. 30. Write for a copy to:

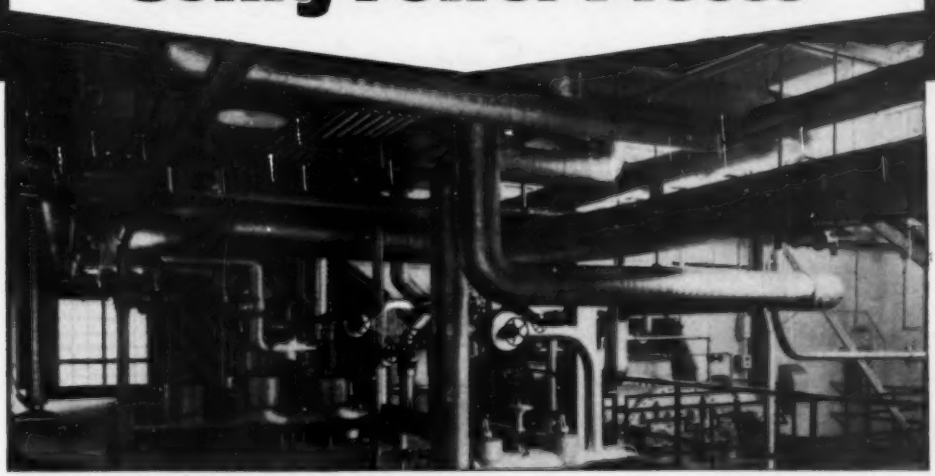
The Chapman Valve Mfg. Co., Indian Orchard, Mass.



Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

CHAPMAN TILTING DISC **CHECK VALVES**

Insulated Better - Using Fewer Pieces



FLORIDA POWER & LIGHT COMPANY'S Sarasota Plant where Kaylo-Insulated piping delivers steam at 850 psig 900° F. Kaylo Insulation is also used at Palatka Plant, with same steam conditions . . . and specified for their Cutler Unit 4, with turbine throttle steam at 1450 psig 1000° F. Distributor-Applicator: North Bros., Savannah, Ga.

Good Reasons Why

Leading Utilities Are Switching to KAYLO HEAT INSULATION

Kaylo Heat Insulation offers advantages right down the line—in *both* performance and application.

This superior insulating material not only has an *effective* temperature range up to 1200° F., it is produced in the widest selection of shapes and sizes. With these features plus Simplified Dimensional Standards, which allow nesting, Kaylo Heat Insulation meets all operating conditions—reduces the number of pieces required per job.

Kaylo Heat Insulation is hydrous calcium silicate, *not glass*. It is insoluble in water, incombustible, and lightweight—yet strong. Easily cut and fitted, it is installed with standard tools.

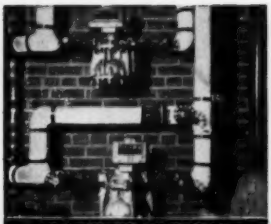
For new installations or maintenance replacement, Kaylo Heat Insulation can do your jobs better . . . *at no extra cost.*

WRITE FOR FREE BOOK—"Kaylo Heat Insulation." Address: Dept. N-314, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

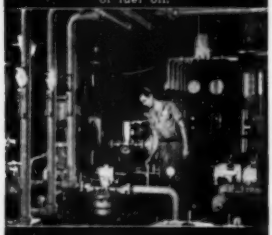
KAYLO® . . . *first in calcium silicate*

. . . *pioneered by* OWENS-ILLINOIS Glass Company

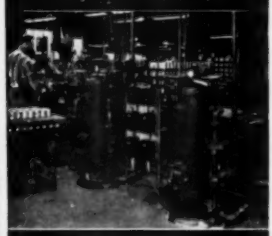
MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • BOSTON • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON



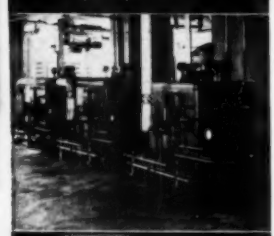
FUEL OIL MEASUREMENT
XACTO METER for accurate control in transfer and storage of fuel oil.



LIQUID BLENDING
BLENDERS for the continuous blending of 2 or MORE liquids.



METALWORKING
FILTERS for continuous coolant filtration systems.



POWER GENERATING
OIL CONDITIONER keeps turbine bearing oil clean — minimizes costly failures.

POWER EQUIPMENT
HYDRO-VOLIFIER* portable oil conditioning unit for transformers, circuit breakers and switch gears.

BOWSER ESTABLISHED 1885

Specialists in . . .

LUBRICATION
FILTRATION
OIL STORAGE
METERING
for industry!

Bowser lubrication and liquid control systems are known for dependability in every type of industrial plant. Operating men have learned to rely on Bowser equipment . . . they know it minimizes downtime . . . lowers maintenance costs — stays on the job day-in-and-day-out.

Installations of Bowser equipment range from individual units to complete systems that serve entire plant facilities.

Bowser can furnish complete engineering service and can supply all the necessary equipment for proper installations. You are assured of complete satisfaction, too, because Bowser will assume the entire responsibility of efficient operation.

Bowser men have "know-how" in the handling of liquids. Consult NOW with the BOWSER man in your territory — there's no obligation!

BOWSER, INC. 1368 CREIGHTON AVE., FORT WAYNE 2, INDIANA

REGIONAL OFFICES • Atlanta • Chicago • Cleveland • Dallas • Kansas City • New York • San Francisco • Washington, D. C. • Hamilton, Ontario

NO BOILER IS EXEMPT!

...that's why we say "draw a bead on boiler sludge, scale, corrosion and carryover"

Tube failure, expense and inconvenience . . .
even plant shut down await those who ignore these potential difficulties in their boiler operations.

Call in the Drew Engineer for thorough investigation, specific recommendations, proper treatment and frequent follow-up service that will clear up your boiler troubles or stop them before they start.

Write for the new booklet "Drew Boiler Water Treatment" describing methods used in overcoming boiler water problems.

Power Chemicals Division

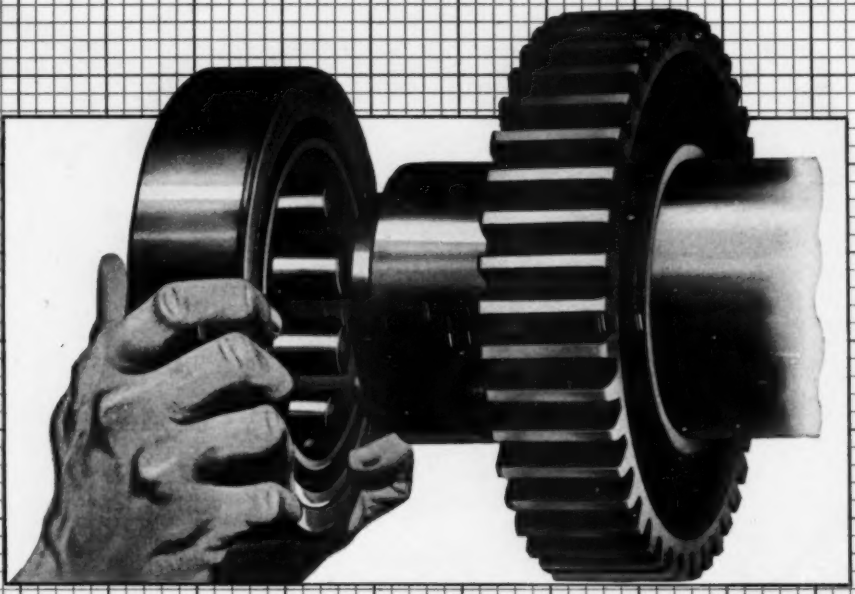
E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS
AJAX, ONTARIO

Service throughout the United States, Canada and South America

DREW PRODUCTS



When Hyatts Go In —Bearing Wear and Care Go Out

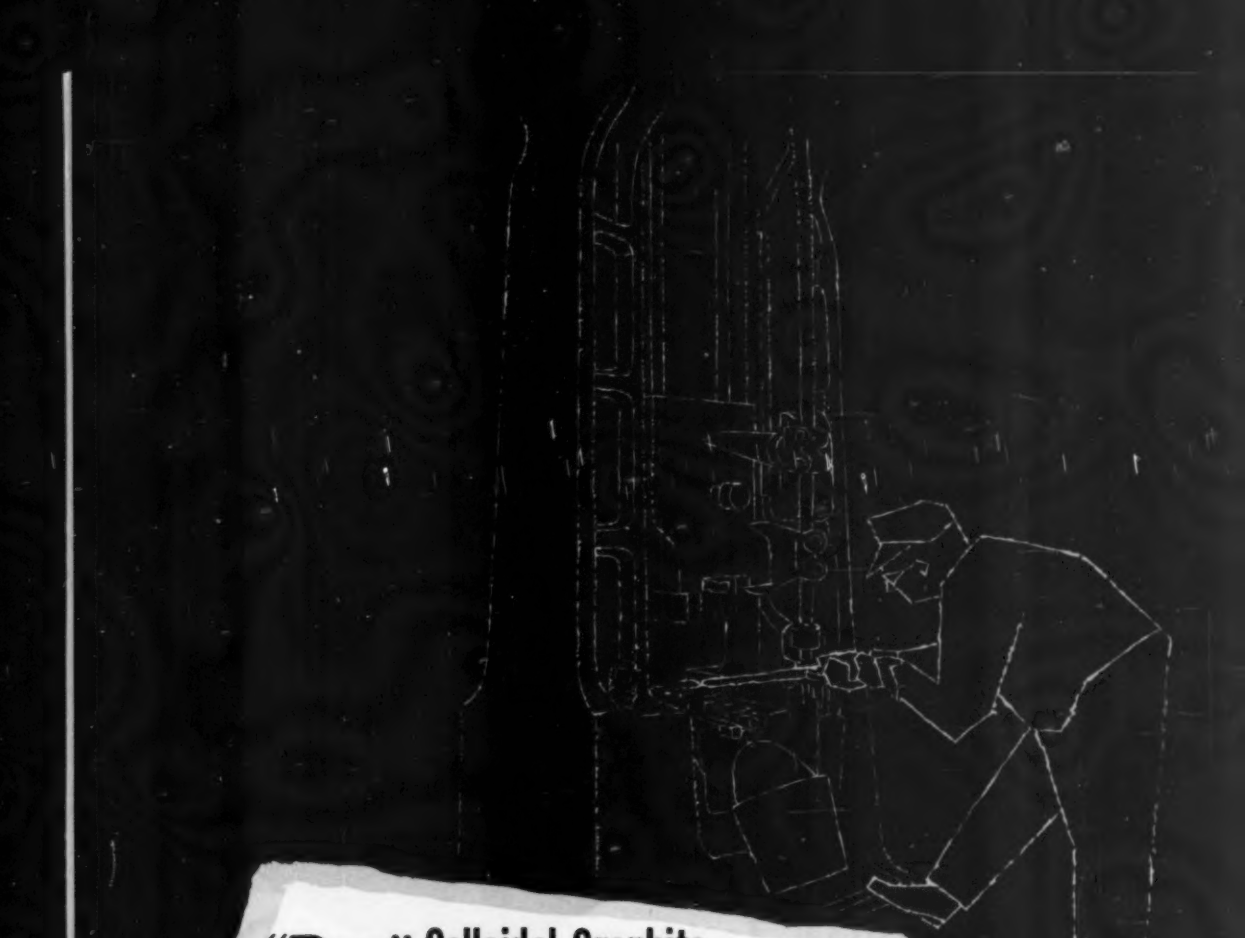
Hyatt has specialized in the manufacture of precision roller bearings for sixty years—serving all branches of industry, agriculture and transportation.

Hyatt Roller Bearings provide maximum load-carrying capacity in a given space, unusual ability to withstand sudden shocks or abnormal temperatures—and they permit axial shaft expansion without binding—no wonder bearing wear and care go out when Hyatts go in.

Leading manufacturers of machinery and equipment in all fields know Hyatts assure the ultimate user longer equipment life, smoother operation and less maintenance.

If there is any Hyatt bearing information you want, write Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS



"Dag" Colloidal Graphite... for Hot-Working Operations

At 500° F., and virtually as far up as you ever go in metalworking operations, **"dag"** colloidal graphite is a lubricant that does not gum up . . . that defies break-down. For brass, bronze, aluminum, magnesium, carbon steel and stainless steel . . . wherever your fabrication problems are friction and heat . . . this unusual lubricant reduces one and resists the other.

"Dag" colloidal graphite is available in dispersions designed to lubricate under all conditions of deep piercing, forging, stretch-forming, wire-drawing and ingot stripping . . . to assist in the parting of castings . . . to lubricate permanently parts that may be subject to extremely high temperatures . . . to be used in degreasing solutions which destroy ordinary lubricants.

When a **"dag"** dispersion is applied to the friction surfaces of metal it leaves a strong, durable graphoid film so thin that even the most sensitive gages cannot detect it. This lubricating film provides the metal with a surface that has an extremely low coefficient of friction . . . a lubricant that resists oxidation and functions far above the burning point of conventional petroleum lubricants.

For more information on the "Use of Colloidal Graphite for Metalworking Operations," write for Bulletin No. 426-17M.

dag DISPERSIONS®

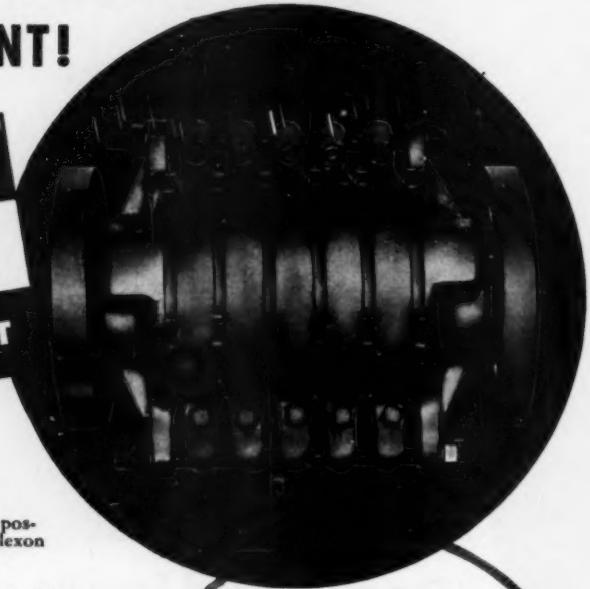
Acheson Colloids Company, Port Huron, Mich.

. . . also ACHESON COLLOIDS LIMITED, LONDON, ENGLAND

Units of Acheson Industries, Inc.

Now you can have GREATER PIPE LINE MOTION CONTROL IN A MORE COMPACT, LESS COSTLY EXPANSION JOINT!

THE NEW FLEXON EXPANSION JOINT



Continuing research and development at Flexonics Corporation have now made it possible to offer design improvements in Flexon Expansion Joints that provide three basic advantages:

1. The face-to-face (over-all) dimension of a joint to handle a given amount of expansion has been reduced.
2. The reduction in size results in a lower expansion joint cost to handle a given amount of motion.
3. Exhaustive tests prove that these joints provide a maximum of motion commensurate with optimum life.

Coupled with such accepted advantages as compactness, ease of installation and freedom from maintenance, these additional advantages make Flexon Expansion Joints the most satisfactory method of controlling pipe line motion for the majority of installations.

Complete specifications are given in the new Flexon Expansion Joint Bulletin. Check this data before you select or specify expansion joints for your plant. Write for your copy, today.

THREE TYPES AVAILABLE

FREE FLEXING—Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 30 psi, temperatures from minus 100°F. to 800°F.

CONTROLLED FLEXING—(Illustrated above) Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 300 psi, temperatures from minus 100°F. to 800°F.

FLEXONIFLEX—Integral ring type. Available in sizes from ⅛" pipe through 6" pipe. Suitable for pressures to 5500 psi, temperatures from minus 400°F. to 1600°F.

Flexonics Corporation EXPANSION JOINT DIVISION 1335 S. THIRD AVENUE · MAYWOOD, ILLINOIS

FORMERLY CHICAGO METAL HOSE CORPORATION

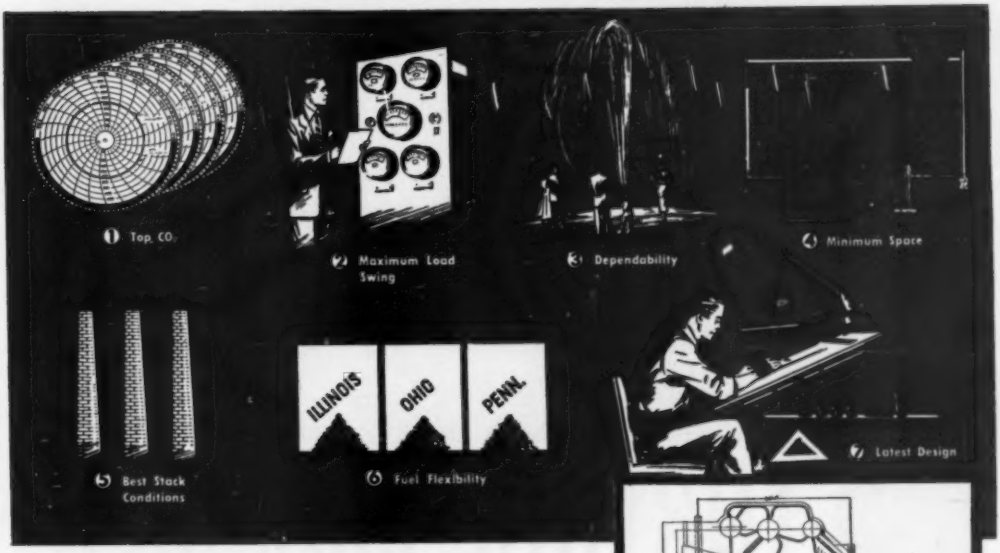
Flexon identifies products of Flexonics Corporation that have served industry for over 30 years.

Manufacturers of Convoluted and Corrugated Flexible Metal Hose in a Variety of Metals · Expansion Joints for Piping Systems · Stainless Steel and Brass Bellows · Flexible Metal Conduit and Armor · Assemblies of These Components

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

ENGINEERED

TO MEET YOUR 7 MUSTS!

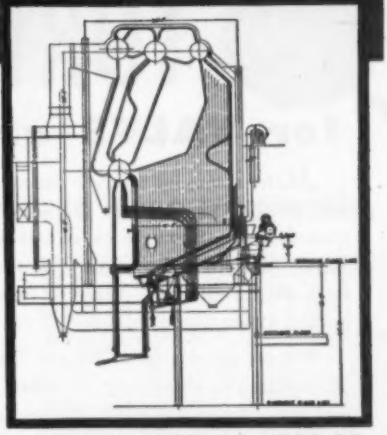


TAYLOR...the truly modern stoker with the old, old name!

WHETHER YOUR NEW POWER PLANT must meet some or all of the illustrated "musts", the engineered Taylor Stoker is your answer.

The famous Taylors are up to the minute in every detail and maintain their well earned reputation for efficiency . . . with proper grate proportions, over 98% of the ash goes to the ashpit. They give you surprisingly quick load response and unequaled dependability. They need minimum headroom and meet the toughest stack-discharge ordinances, too. And the Taylor Stokers offer all this, burning coal from all parts of the U. S. as well as from Canada, England and the Continent.

Whether your new plant must deliver 20,000 or 500,000 lbs. of steam per hour, ask your Consulting Engineer about Taylor Stokers. And send for booklet, today.



Water cooled 10-retort Taylor Stoker with Babcock & Wilcox four-drum boiler in use by the Municipal Light and Power Plant, Troy, Ohio. This unit has a capacity of 100,000 lbs. per hour and operates with an average of 14½% CO_2. Consulting engineers were William C. Kammerer and Associates of Cleveland.

AMERICAN ENGINEERING

COMPANY

PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2406 Aramingo Ave., Philadelphia 25, Penna.

Gentlemen:- We are interested in getting top efficiency from both low and high ash coals. Please send us full information about Taylor Stokers.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

TORTURE CHAMBER

for VALVE and FITTING MATERIALS

Here, steam up to 1500 pounds pressure and 1000° F. gives Vogt the answer to any question of materials or construction for valves and fittings in just a few days . . . facts that would take years to obtain under normal operating conditions!

We set up our own Torture Chamber to determine the durability of valve packings and gaskets; the resistance of various steels to corrosion and erosion; and how hard and how smooth surfaces of seats, discs and stems must be to withstand steam at high pressures and high temperatures. We tested and found an ideal yoke nut material, and we uncovered facts on joint design that could be found in no other way.

Thus, by constant and accelerated testing, we quickly and definitely prove or disprove the claims that are made for many newly developed materials. And thereby we make sure that only the best goes into valves and fittings that bear the name Vogt.

Consult Catalog F-9 for the complete Vogt line of drop forged steel valves, fittings and flanges for steam, water, oil, gas, air and refrigeration services.

HENRY VOGT MACHINE CO., Louisville 10, Ky.

BRANCH OFFICES: NEW YORK • CHICAGO • CLEVELAND
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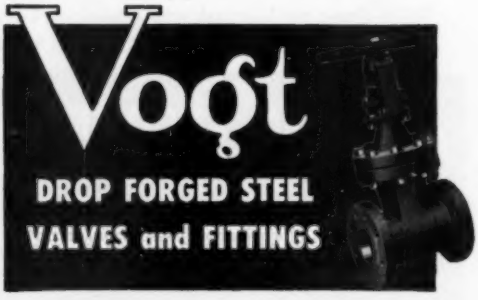
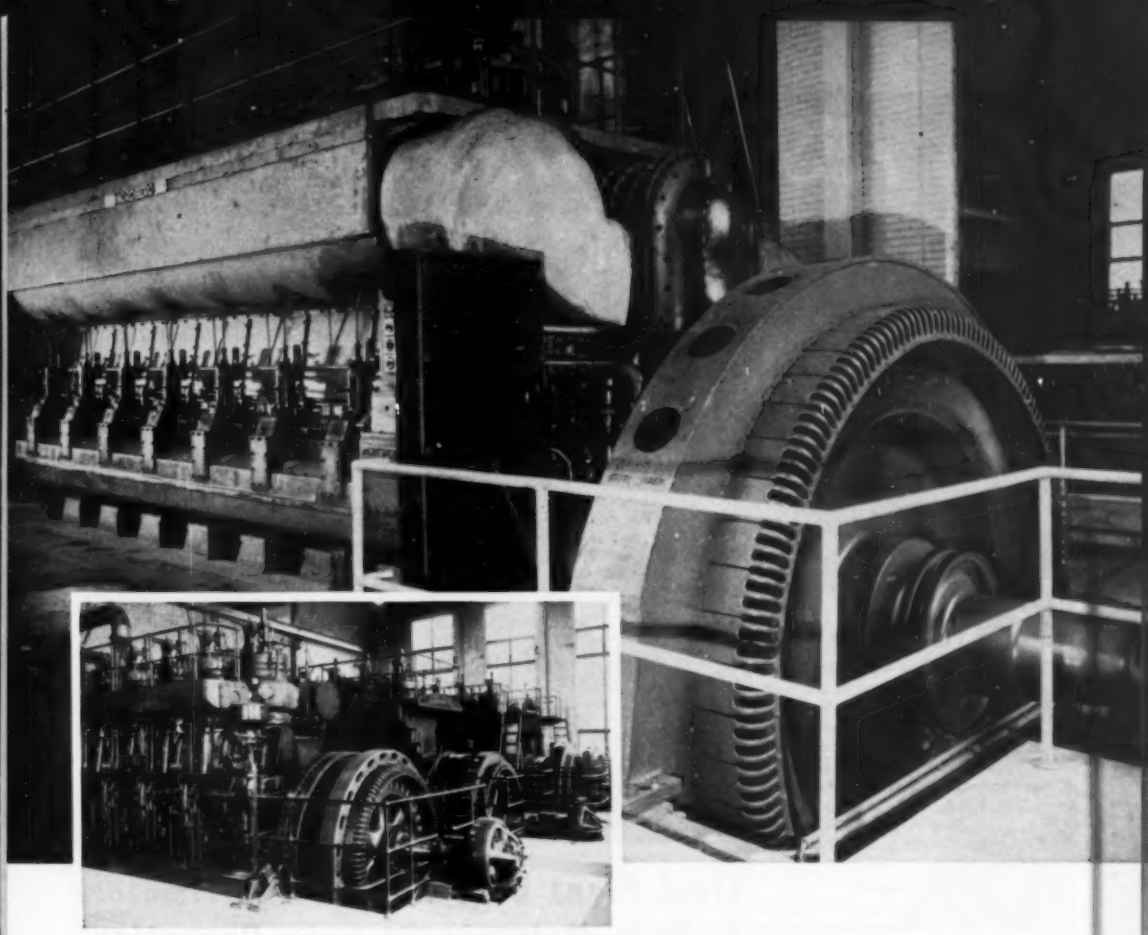




Rensselaer, Indiana, plant gets record economy with...

● Shown above are the five diesel engines, totaling 7,150 hp., which make the Rensselaer municipal plant one of the largest of its kind in Indiana. The efficient operation of these diesels has helped keep Rensselaer's lighting rates among the lowest in the state for cities in the 2,500 to 10,000 population group.

Contributing to this successful record, Standard Oil's diesel fuel and lubricants have helped keep operating and maintenance costs low. STANDARD HD Oil has played a particularly important role. This outstanding heavy-duty lubricant has provided effective lubrication of vital cylinder areas. It has kept cylinders and rings protected against excessive wear and free from deposits. How these benefits contribute to high operating efficiency is shown by the performance of the plant's newest and largest diesel, a 2,800-hp unit. In a typical month, this unit has operated for 444 hours, carried an average load of 54%, and generated 13 kw-hr per gallon of fuel with a lubricant consumption rate of 9,414 hp-hr per gallon.

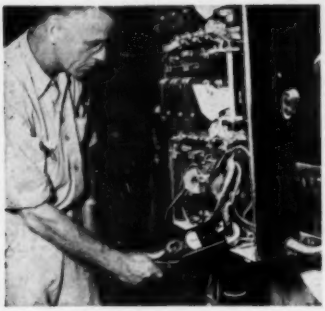
Throughout the Midwest, diesel operators are getting record efficiency and economy with the help of STANDARD HD Oil. The Standard Oil lubrication specialist in your area will be glad to give you information concerning the use of this superior heavy-duty lubricant in plants with which you may be familiar. Just phone your local Standard Oil Company office for his services. Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Illinois.

STANDARD HD
TRADE MARK
OIL

STANDARD OIL COMPANY

STANDARD (*Indiana*)

TESTING TIPS for the maintenance of plant equipment



Firestone Tire and Rubber Company Saves Four Hours With G-E Power-factor Meter

"The AK-3 enables us to gain very definite savings in time, money, and manpower. We now save four hours per reading over the use of the analyzer method by using the new G-E hook-on power-factor meter," reports G. H. Kaufman of the Firestone Tire and Rubber Company. Mr. Kaufman is chief field electrician at the Los Angeles plant where tires, rubber products, and fuel cells are manufactured.

DIRECT READING

Since the AK-3 is direct reading, no calculator cards or interpolation is required: just clip on the voltage leads, clamp the hook around the line, and rotate the dial with your thumb to get the reading.

If your power factor is now	you can release this much extra capacity	with this many capacitors for each 100 kw of load
65%	34%	84 kvar
70%	29%	69 kvar
75%	23%	55 kvar
80%	17%	42 kvar
85%	11%	29 kvar
90%	5%	15 kvar

(Power factor is raised to 95%. New load is at original power factor.)

When making capacitor surveys you'll find the AK-3 a valuable time saver. The table above shows what you can expect from adding needed capacitors to your feeder lines. Accurate to within 0.05 PF the AK-3 can be used on a-c circuits with voltages from 100–600 volts and currents from 15–600 amperes. Available from stock the AK-3 is $87.00*

*Mfgs. suggested retail price.

Lower Price — Wider Range — Pointer Stop New G-E Hook-on Volt-ammeter Features

Now available, the new General Electric AK-1A hook-on volt-ammeter boasts a wider range and pointer stop at the new low price of $66.75*. A positive-action selector switch gives ranges of 0–7.5/30/75/300/750 amperes and 0–150/300/750 volts a-c. The new pointer stop is easily adjusted to permit reading of motor-starting currents.

READ AMPS QUICKLY

This versatile portable instrument measures current by simply hooking the jaws around any insulated or uninsulated a-c conductor—no cutting into line, no interruption of service.

CHECK VOLTS EASILY

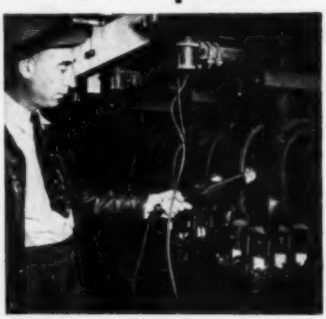
For voltage readings you simply flick the selector switch to the desired scale, connect the voltage lead to the terminals, and then clip the extra-large alligator clips across the line.

HIGHLY ACCURATE

The AK-1A is magnetically shielded so that 500 amperes in a conductor one foot away from the transformer causes negligible effect on the 300- and 750-ampere ranges, and less than one percent error on the other current scales. Dovetail joint on the magnetic jaws reduces errors from dirt that may accumulate in the air gap. Errors caused by imperfect closing are held to less than two percent, where the ordinary butt joint might cause a 10 percent error. For more information, write for Bulletin GEC-901, or to order the AK-1A specify Catalog No. 549X95. Price: $66.75*

Steel Plant Uses Hook-on Wattmeter To Help Maintain 24-hour Operation

The electrical foreman of a West Coast steel plant reports satisfaction with his G-E AK-2 hook-on wattmeter. "We never get a shutdown here—operate 24 hours a day and in order to get readings without interrupting service we use the G-E hook-on type instruments." This foreman is using the AK-2 to determine the kilowatts going through an auxiliary feeder to a 24-inch mill; he can thus plan changes to be made during holiday periods.



EASY TO USE

Maintenance men appreciate the simplicity and extreme portability of the AK-2. Power is measured by clamping the jaws around any a-c line up to two inches in diameter. The two potential leads are connected across the line and watts, (vars in a balanced three-phase circuit) are read directly with an accuracy of ±3% full scale. The AK-2 will measure up to 300 kw, on ranges 15–600 amperes, and 100–600 volts. Price $87.00*

When ordering bulletin, write to Section 602-241, General Electric Company, Schenectady, N. Y.

BUY NOW

From Your Nearest G-E Distributor

GENERAL ELECTRIC

Plan Your Boiler Installation this Way..

...to Balance Load Factor with Low Investment
...to Meet Present Needs and Future Expansion...

CLEAVER-BROOKS self-contained steam boilers are the answer to both present and future steam needs. You can install Cleaver-Brooks boilers in units to fit your present steam capacity requirements . . . keeping your investment at a minimum and your boiler efficiency at a maximum. Here's how it works . . .

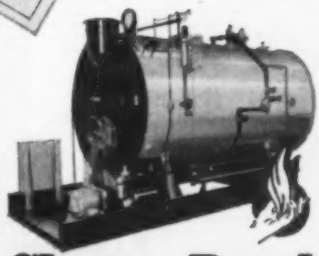
Your initial Cleaver-Brooks boiler installation is made in the size or capacity to fit your present steam load — this assures full use now at top efficiency and low capital investment.

As increased steam needs arise, additional Cleaver-Brooks boilers can be added to keep pace with your expanded requirements.

With this flexible program, you have the greatest return from your boiler investment — minimum original cost and lowest operating cost. Your boilers are always operating at maximum efficiency (80%) over the entire working range (30 to 100%).

Cleaver-Brooks self-contained boilers are ideal for multiple installations because of their compactness, low headroom requirements, fast installation, automatic operation, range of sizes. Available in standard models—15 to 500 hp.; 15 to 250 psi; gas, oil or combination gas and oil fired units.

Get all the story — write today for latest catalog.

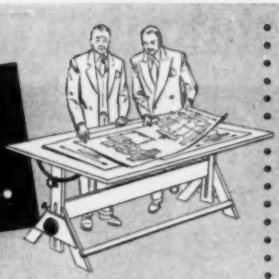


Cleaver-Brooks

Dept. P, 302 E. Keefe Ave., Milwaukee 12, Wis., U.S.A.
Cable Address: Clebro-Milwaukeewis

Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners

HOW SPENCE DESIGN...

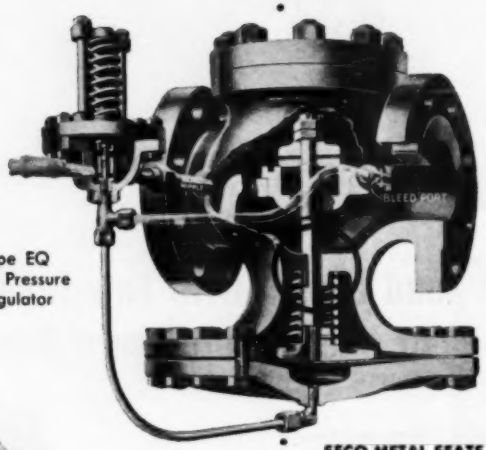


eliminates stuffing boxes

All Spence main valves and most pilots are built without stuffing boxes. This packless construction is made possible by the use of a large balanced metal diaphragm which eliminates the need for closely fitted parts. Result? More accurate regulation.

Valve stem wear is also reduced in the Spence packless design. Result? Low maintenance, years of trouble-free service.

Spence makes a wide line of automatic regulating valves: Pressure, Temperature, Differential Pressure, Back Pressure, Pump Governors and many other types. Write for bulletin 100 giving full details.



Type EQ
Back Pressure
Regulator

A few other design features:

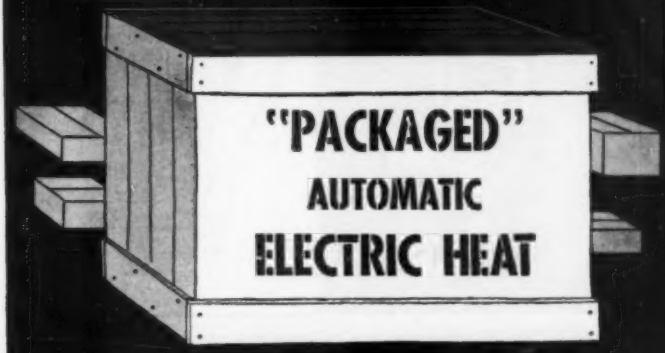
SECO METAL SEATS AND DISCS— Durable SECO Metal resists wiredrawing. More than twenty years of experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PROTECTED SPRINGS— The internal springs in the Spence Main Valve and Pilot are out of the path of the steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life.

METAL DIAPHRAGMS — Located in a cooled zone with a condensate seal above and below, never have to be replaced under normal conditions.

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK



"PACKAGED"
AUTOMATIC
ELECTRIC HEAT

combining Heater and Thermostat in one unit

ready to go on your Jobs!

● CHROMALOX 'Packaged' Electric Heaters are ideal as permanent or portable heat sources in tanks, drums, process kettles and other containers. With CHROMALOX Heaters you can heat accurately and maintain the temperature of degreasing, cleaning, pickling and plating baths. You can melt greases, asphalt and similar viscous fluids. CHROMALOX Units may be had in the types, sizes and wattages required to efficiently do your heating jobs. They are available with sheaths of copper, stainless steel, alloy and lead for resisting the corrosive actions of the solutions you are using.

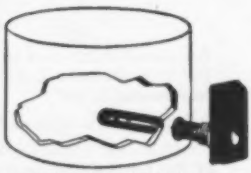
Nation-wide engineering service for on-the-job assistance and recommendations. Write, wire or phone for the name of the Chromalox Engineering Representative serving you.

CHROMALOX

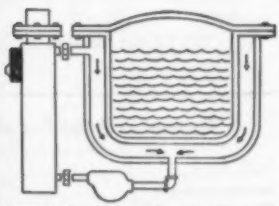
Electric Heat for Modern Industry

Variety and Versatility to fit your Needs Exactly

Chromalox Immersion Heaters with built-in thermostats for portable or permanent use. Drawing illustrates Immersion Units, equipped with sludge-legs, installed over the side of the tank for direct heating. Available in various metal sheaths to resist the corrosive action of the liquid compounds.



Compact, thermostatically controlled, screw-in type Chromalox Immersion Unit is easily installed in smaller tanks and other containers. Thermostat range is 100° to 180° F.



Chromalox Circulation Heaters give accurate, even trolled heat up to 750° F. for heating Dowtherm, Aroclor or heat transfer oils. Other uses include water heating applications such as steam boilers and accumulators, kettles, tanks and processing equipment, preheating fuel oils, heating air, nitrogen and other gases; drying steam, plastic powders, etc.

Clip Coupon

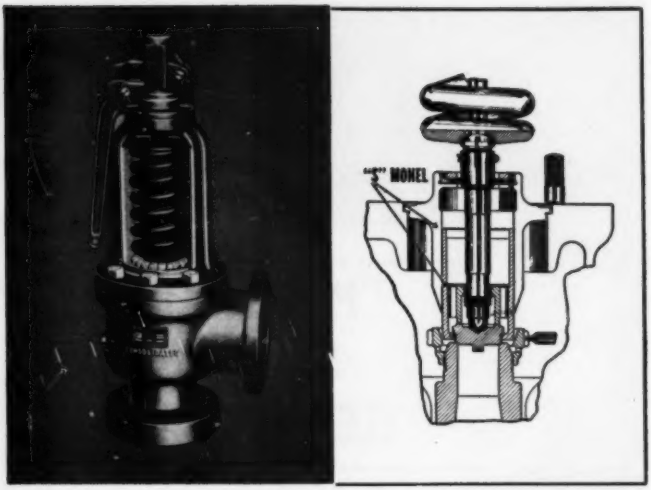
For complete details showing how to use Chromalox Heaters in your applications.

Industrial Division IC-86
EDWIN L. WIEGAND COMPANY
7528 Thomas Boulevard, Pittsburgh 8, Pa.
Please send "100 Ways to Apply Electric Heat" booklet.

Name_____
Address_____
City_____ Zone____
State_____

'S' Monel...

FOR RESISTANCE TO GALLING AND EXTRA HARDNESS AT HIGH TEMPERATURES



"Consolidated" Safety Valves like this have guide sections of extra hard "S" Monel. Manning, Maxwell & Moore, Inc., standardized on "S" Monel after extensive tests under simulated operating conditions. All proved "S" Monel an outstanding metal for resistance to galling and seizing.

Are you looking for a casting alloy for parts subject to high stress and severe friction under corrosive conditions?

Then take a look at "S" Monel.

"S" Monel is one of the hardest and strongest of the non-ferrous casting alloys.

Its coefficient of expansion closely matches that of carbon steel to give excellent service where clearances are small and operating temperatures high.

"S" Monel retains its hardness at elevated temperatures. It resists galling under severe conditions, even where lubrication is poor.

And because of its hardness it is highly resistant to abrasion and erosion.

It can be machined as cast. For extensive machining the casting may first be annealed and later age-hardened to develop its maximum hardness. It is not recommended for welding.

You'll find "S" Monel used as the guiding parts in safety valves, in valve discs and seats, impellers, wearing rings, bushings, sleeves, ejector nozzles and pump liners.

"S" Monel has helped many manufacturers in solving their metal selection problems.

Take for instance the problem of Manning, Maxwell & Moore, Inc.

They wanted a valve trim material that would hold up in the "Consolidated" Safety Valves.

The material had to be able to resist galling and seizing at high temperatures.

Many alloys were tested in combination with themselves and with other alloys, and "S" Monel consistently showed superior anti-galling properties. Now "S" Monel has been made the standard for the guiding sections of their high temperature "Consolidated" Safety Valves.

For more information on "S" Monel, write to Inco's Technical Service Section. They'll be glad to supply you with information and assistance.

Mechanical Properties of "S" Monel*

(Annealed and Age-hardened)

Yield Point	80-115,000 psi
Tensile Strength	120-145,000 psi
Elongation in 2-in.	4-1%
Hardness (Brinell)	300-375
Coefficient of Thermal Expansion (32°-212°F.) in./in/°F.	.0000068

Hardness of "S" Monel at Elevated Temperatures*

(As-cast condition)

Temperature, °F.	Brinell Hardness
Room	321
700	321
800	311
900	311
1000	321
1050	335
1100	293

*Average properties—not to be used for specification.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Inco Nickel Alloys

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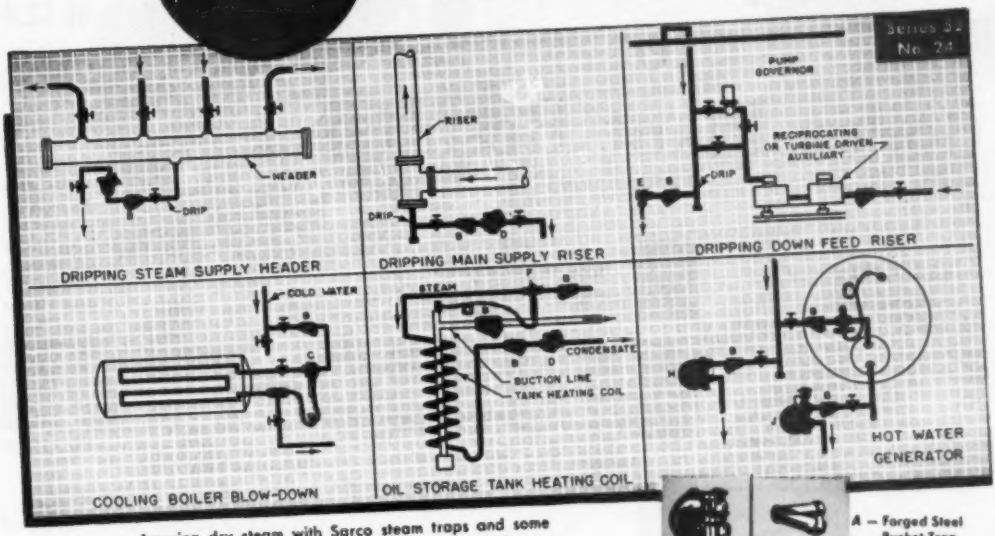
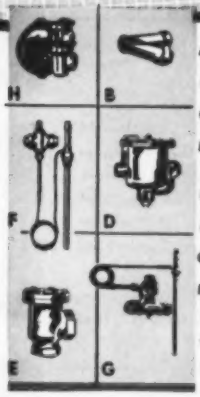
SARCO in the boiler house...



Assuring dry steam with Sarco steam traps and some Sarco temperature control hook-ups in the boiler house.



A — Forged Steel Bucket Trap
B — Pipe Line Strainer
C — Temperature Regulator, TR-19
D — Inverted Bucket Steam Trap
E — Thermostatic Steam Trap
F — Temperature Regulator TR-21
G — Temperature Regulator 24-2U
H — Float-Thermostatic Trap, type FTS
J — Float-Thermostatic Trap, type FTD-M

STEAM TRAPPING AND TEMPERATURE CONTROL problems begin right where steam is generated. The modern boiler plant with its maze of piping and auxiliary equipment offers striking evidence of the advantages of a complete line from one source of supply.

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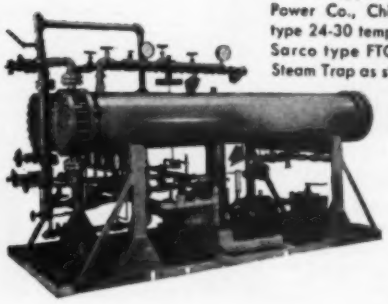
SARCO saves steam
improves product quality and output



Enterprise dual pump set to preheat 3,200 gph of Bunker C fuel oil to 225°F. Supplied by Enterprise Heat & Power Co., Chicago, Ill. with Sarco type 24-30 temperature regulator and Sarco type FTQ Float-Thermostatic Steam Trap as standard equipment.

423

Hays Guide to Boiler Plant Results

increased efficiency

"Operating efficiency has been as high as 82%—much of the credit going to the accuracy of (Hays) automatically controlled combustion."

SHERWIN WILLIAMS, Chicago Plant

low maintenance

"we find that due to the (Hays) properly controlled combustion, our maintenance on both stokers and boilers has been considerably decreased."

AMERICAN TOBACCO COMPANY

fuel savings

"we estimated that . . . we would be able to pay for the new equipment (Hays Combustion Control) out of the fuel savings in three years. Since then, the records show that the amortization of the original investment has been accelerated."

RAYBESTOS-MANHATTAN, INC.

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"we have made test runs using the Hays system, bringing the load rapidly up from 8,000 to 80,000 lbs per hour with excellent results. Fuel-air ratio was held at the desired value and CO_2 at 15%."

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HAYS COMBUSTION CONTROL GETS RESULTS . . . *Proof of this statement is available in the form of case histories on the boiler plant experience of 9 leading companies. These "result stories" cover small, medium, and large boilers —burning all types of fuel, including alternate fuels—with different load characteristics—and different uses for steam.*

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Large Power Producer Meets Demands up to 400,000 lb per hour with Evaporation Rate of 12.8

"During the many years we have been generating power at Scovill Manufacturing Company, Waterbury, Conn.," says Leo Niekerk, Power Plant Chief Engineer, "we have evolved a general philosophy for power plant operation: buy the best equipment available, then operate and maintain it in the most intelligent way possible. We have two power houses—the West Power House containing one 500 kw vertical turbine, one 3,000 kw condensing turbine generator, and two 600 hp oil-fired 150 psi boilers on standby; and the East Power House containing three 3500 kw condensing turbines, one 5,000 kw topping turbine, six 600 hp stoker-fired 250 psi boilers and, handling most of the load, two 660 psi oil or pulverized coal-fired steam generating units rated at 225,000 lb/hr and 150,000 lb/hr."

fuel handling

"Coal from railroad cars is transferred to overhead bunkers by a conveyor system. Fly ash from dust collectors is removed by conveyor ash handling system and discharged through an outside silo. Oil is stored in two 150,000 gal. tanks and fed by gravity to the fuel oil pumps in the basement."

combustion control

"When we installed our Boiler #1 in 1940 we selected Hays Combustion Control. We were so pleased with its operation during the next six years that when we installed Boiler #2 in 1946 we again specified Hays Combustion Control. Each boiler has its own Hays panel containing a complete complement of modern boiler room instruments and controls. Currently we are meeting steam demands up to 400,000 lb per hour (with load swings as high as 60,000 to 70,000 lb per hour) while achieving an evaporation rate of 12.8, a fuel cost per kw of $.0049, and a cost per thousand pounds of steam of $.706. No small part of the credit for the versatility and efficiency of our operations should go to the Hays Combustion Control System. Maintenance expense on the control system has been negligible.

The above story is a condensation of a completely illustrated case history on the power plant operation of Scovill Manufacturing Company. Write for Bulletin R-8, available free from The Hays Corporation, Michigan City, Ind.

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You may be surprised at how much faster your product can be produced when Yarways trap your steam equipment. Yarway Impulse traps are designed with production in mind. They insure sending maximum B.T.U.'s at top temperature into your process or product. They get equipment hotter, *sooner* . . . and keep it hot!

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VOL. 63 • NO. 6 — INDUSTRY AND POWER — DECEMBER 1952

FUEL FLEXIBILITY AT HOWARD UNIVERSITY POWER HOUSE

Many power plants are restricted by design to the utilization of only one of the conventional fuels: coal, oil and gas. Howard University recently corrected this condition at their plant by installing a coal fired steam generator to supplement existing oil burning boilers. Now fuel selection based on current prices and available supplies assures continuous economical operation

WILLIAM S. MAJOR, *Project Engineer*
Machinery Division, Dravo Corp.

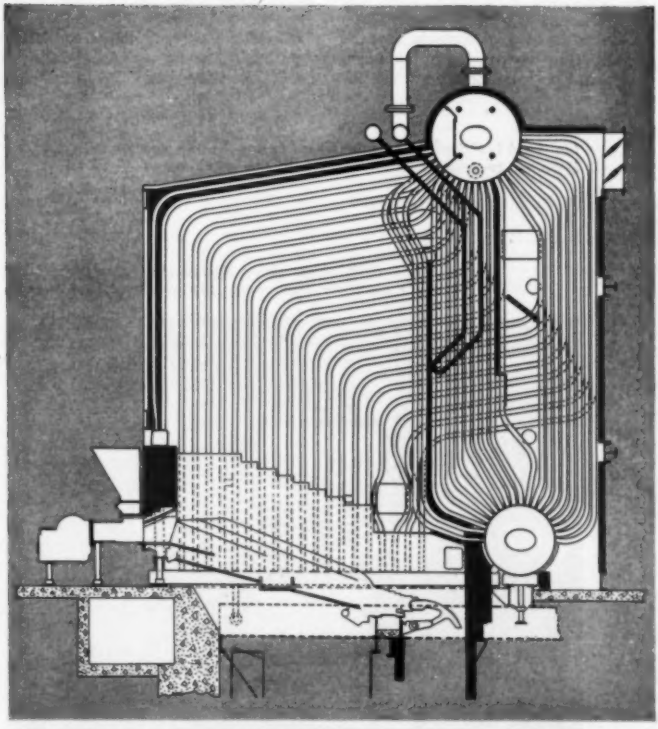


Fig. 1—New steam generator is a two drum stoker fired unit with fully water cooled furnace. Stoker and FD fan are turbine drives. ID fan has motor drive

WITH INCREASING variation in both prices and supplies of fuels, more plants are providing means for using two or more of our basic fuels: coal, oil and gas. Generally, newer and larger plants obtain fuel flexibility through the use of a boiler and furnace configuration designed for burning either solid and liquid and/or gaseous fuels. In other cases, particularly older plants, it is not unusual to find the furnaces designed for the use of only one fuel. Under such conditions, fuel flexibility is being incorporated in the plant when there is a need for additional steam generating capacity. For instance, at the Howard University Power Plant in Washington, a coal fired steam generator was recently installed to supplement two oil fired units.

Boiler Design

Fig. 1 shows a sectional side elevation of the new underfeed stoker fired, two drum boiler. It is designed for generating 50,000 lb of steam per hr at 200 psig with 50 F superheat from feedwater at 212 F when burning coal of about the following analysis:

Per cent moisture as received - maximum	4.0
Per cent volatile matter - maximum	26.0
Per cent ash - maximum	12.0
Ash softening temperature - deg F	2580
Average heating value as fired - Btu per lb	13,890

Table 1 shows predicted performance data at three steaming rates when burning coals with these characteristics.

Since the water cooled furnace is

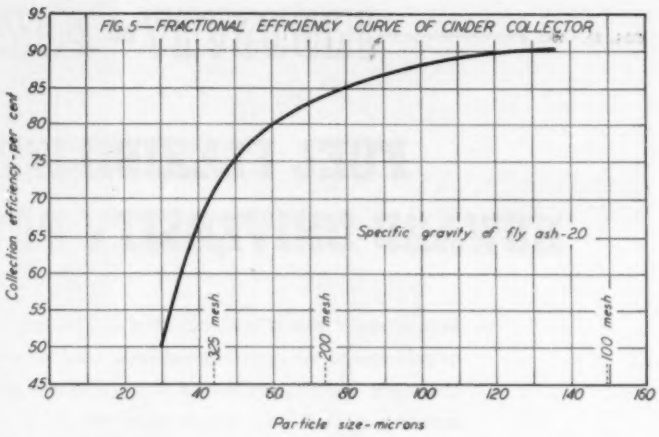
conservatively proportioned, coals of lower grades may be burned without slagging of the boiler surfaces or objectionable fuel bed disturbances. For example, when using coals of about 15 per cent ash with softening temperature of approximately 2300 F, the unit operates satisfactorily at steaming outputs of nearly 40,000 lb per hr.

Combustion Control

Coal and air supply to the furnace is automatically controlled through a steaming range of 5000 to 50,000 lb per hr. The controls are of the air actuated, metering type with separate units for regulating: (a) forced draft fan turbine, (b) induced draft fan damper, (c) furnace pressure and (d) stoker driving turbine. This system maintains tolerance limits as follows: (a) CO_2 in the boiler exit gases within plus or minus one per cent of the desired content, (b) furnace draft within 0.01 in. wg of the predetermined pressure, (c) main steam pressure within plus or minus two psig of the established operating pressure. Other features of the control system include automatic stopping of the forced draft fan in event of induced draft fan failure, and convenient means for switching to manual control.

Instrumentation

Instrumentation includes a three pen combination recorder for steam flow, air flow and boiler exit gas temperature. In addition, there is a two pen meter which records feedwater flow and water level in the boiler drum. A multipointer draft gage shows pressure under the stoker grate, draft in the furnace, draft at the boiler outlet, and draft at the induced draft fan inlet. All control devices and instruments are assembled on a panel board that also contains the remote water level indicator, operating controls for the ash handling system, indicating steam gage, and push button control for the operation of the automatic coal weighing scale that was installed to facilitate determination of coal consumption.



Coal Handling and Storage

Although limitations precluded outdoor coal storage adjacent to the plant, some coal storage has been realized through effective use of the overhead boiler room space in front of the two oil fired boilers. This space was utilized for the installation of a 240 ton bunker, which represents about six days operation based on generating

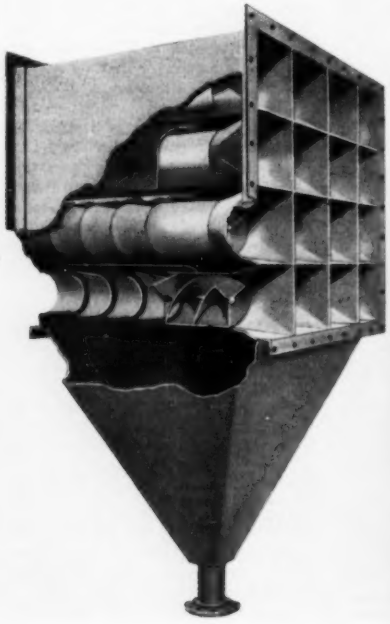
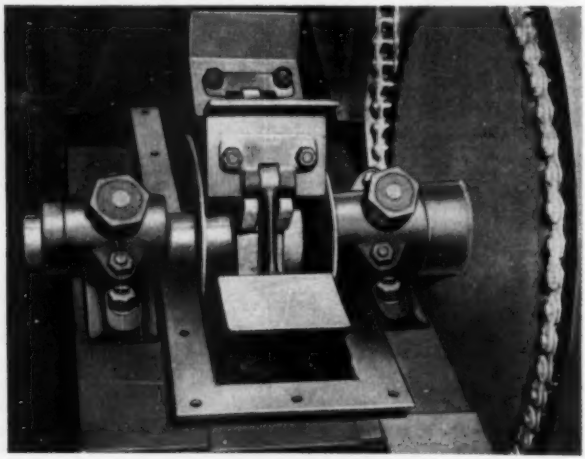


Fig. 4—A low draft loss impingement type collector was installed to minimize dust loading in the stack gases

Fig. 3—This photo shows design characteristics of the flight conveyor that serves the overhead coal bunkers



steam at a rate of 35,000 lb per hr. This is over and above the two day equivalent steam capacity of the live bunker. By means of gates at the bottom of the storage bunker and a totally enclosed, dust-tight conveyer system as shown diagrammatically in Fig. 2, the coal can be transferred readily to the live bunker. Fig. 3 reveals design characteristics that are used on the vertical flight conveyer. As coal leaves the live bunker it passes through the automatic weighing scale before entering the nonsegregating chute that feeds the stoker hopper.

The entire region above the coal bunkers was converted into a sealed room by erecting a dust-tight partition from the top of the bunkers to the ceiling. This eliminates any dust problem in the boiler room when coal is being discharged from the conveyers to either of the bunkers.

Coal Delivery and Ash Removal

Delivery of coal and removal of ashes is by truck, both services being consolidated in one enclosure that has been framed into the boiler room. A large window at one end of the firing aisle was removed so that a truck could be backed into the enclosure. In this area, a coal receiving hopper was installed at ground level and an ash storage hopper overhead. Concrete walls supporting the ash bunker and a cinder block wall form the enclosure which seals off the area from the firing aisle.

Coal from the receiving hopper discharges to a 30 ton per hr conveying system that feeds it from the basement to the bunkers. The overhead ash bunker is connected to a pneumatic type, steam operated piping system with a handling capacity of 8 tons per hr. At this rate of operation, it can transport the ashes from a complete day's run at full steaming load to storage in less than one hr.

Cinder Collection

At the time the new coal fired boiler was under study, special attention was given to design features that would assure low smoke density and dust concentration in the stack gases. Under normal operating conditions there is every reason to expect that the underfeed stoker with a conservative burning rate and furnace configuration would meet most smoke and dust ordinances without a trap or collector. As an added protection, however, a low draft loss, impingement type cinder collector as shown in Fig. 4 was installed. It is designed for removing not less than 75 per cent of all solids contained in the gases which will be retained on a standard 200 mesh screen. From the fractional efficiency curve, Fig. 5, it will be noted that the predicted collection for plus 200 mesh screen particles is substantially above the required performance. Because of this, considerable wear and loss of collection efficiency could occur before performance drops below design level.

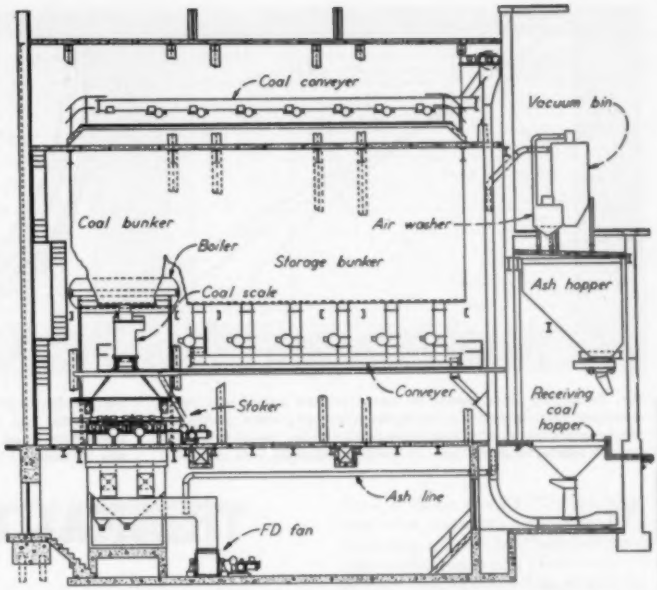


Fig. 2—Cross sectional drawing shows principal equipment that was added to permit firing coal as an alternate to the existing oil burning facilities

TABLE 1—DESIGN PERFORMANCE

Actual evaporation—lb per hr	25,000	37,500	50,000
Gas temperature leaving boiler—deg F	476	520	564
CO_2 in boiler exit gases—per cent	11.8	12.7	13.1
Combined boiler and furnace efficiency—per cent	78.8	78.3	76.9
Furnace heat release—Btu per cu ft per hr	15,100	23,700	30,600
Burning rate—lbs per sq ft of grate area per hr	17.2	25.9	35.2

TABLE 2—PRINCIPAL EQUIPMENT

Boiler and superheater	Erie City Iron Works
Stoker	Riley Stoker Corp.
Forced and induced draft fans	Green Fuel Economizer Co.
FD fan turbine	De Laval Steam Turbine Co.
ID fan motor	General Electric Co.
Cinder collector	Fly Ash Arrestor Co.
Ash removal system	Allen-Sherman-Hoff Co.
Coal handling equipment	Link-Belt Co.
Combustion control	The Bailey Meter Co.

Smoke Control

Operators are aided in the control of smoke density by an electronic type indicating meter that is placed conspicuously on the control panel. When smoke to the stack exceeds a predetermined density, the green signal shuts off and a red light signal flashes on. Thus, the operator knows that corrections in firing practice are required to eliminate abnormally dense smoke.

Since the installation of this new steam generator, the plant steam load can be carried with either coal or oil as may be dictated by prices and/or supplies of these fuels.

Plant modifications and equipment specifications for the new steam generator and auxiliaries resulted from engineering studies prepared by the General Services Administration, Public Buildings Service in Washington, D. C. Construction engineering was handled by Dravo Corporation, Pittsburgh.

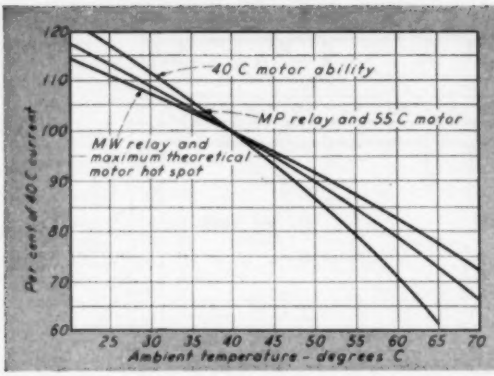

40 C motor ability
MP relay and 55 C motor
MW relay and maximum theoretical motor hot spot
Per cent of 40 C current
Ambient temperature - degrees C

Fig. 1—Ability of a motor to carry a load safely and the minimum trip current for relay heaters vary with ambient temperature at nearly the same rate, giving good protection at ambients other than 40 C (for both relay and motor)

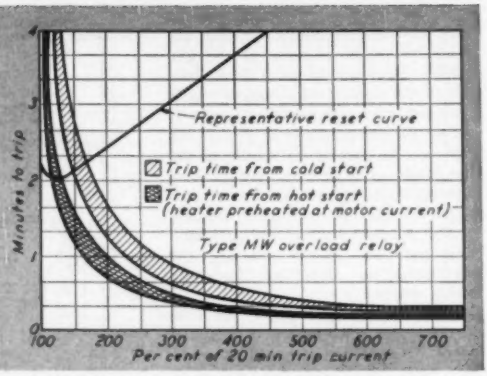

Representative reset curve
Trip time from cold start
Trip time from hot start (heater preheated at motor current)
Type MW overload relay
Minutes to trip
Per cent of 20 min trip current

Fig. 2—Thermal relays have a desirable inverse time characteristic, but curve is really a band, due to individual variations, and shifts from right to left depending on the amount of preheating developed by the motor current

THERMAL RELAY HEATERS

Thermal type overload relays are popular because of their simplicity, give adequate protection for most applications. But their limitations must be considered for best service under conditions of different ambients, intermittent loading and

MANY TYPES of overload relays for motor protection have been built and marketed over the past years. There is an old instantaneous-trip magnetic relay and a similar one with an oil dashpot for inverse-time delay. There have been transformer types of relays, solder-pot, ambient-compensated, induction-disc, mercury-tube, bimetal relays, built-in-motor, expansion tube, bellows-tube relays, and even relays that will stand the shock of bomb hits on Navy vessels. Many of these relays were built for special applications or had one or more special advantageous features.

Today, this group has pretty well simmered down for most uses to a simple form of thermal operated, overload relay which may not give all the protection that could be desired on all applications, but which fits well on a large majority of applications. These relays have reached such a wide use and acceptance because they are small, simple, reliable, and economical. If they are properly and intelligently applied, they will give good overload protection.

There are two ways of selecting heaters. One is by using published heater application tables which usually list the heater identification and a range of motor currents or horsepower for which this heater provides protection. There is always a set of conditions which go with such a table, however, and must be taken into consideration carefully or misapplication may result. These conditions involve motor ambient, starter ambient, starter enclosure, and other sources of heating and cooling.

The second method involves all basic relay information such as heater rating, ambient of rating, trip temperature, effect of ambient on trip rating, and many other factors. This obviously would be too cumbersome and slow if many applications were involved.

Heater application tables are reliable within their specified limitations and represent the better method. However, knowing the characteristics of thermal relays will help in choosing the right table and permit compensation in case there are factors not exactly covered.

The following information covers fundamental characteristics of thermal relays, their relation to motors, and the relation of overload relays to certain circuit conditions. Much of this information is a primary requisite to the proper engineering application over a wide range of conditions.

Effective Ambients

Overload relays are usually calibrated and applied on the basis of a 40 C ambient because most standards applying to control applications are based on that reference, as are standard motor ratings. Fig. 1 shows that minimum tripping currents for one type of relay heater vary with changing ambient at approximately the same rate as the load a motor can safely carry. Therefore, heaters properly selected for protection in a 40 C ambient will provide proper protection at any other ambient temperature for both motor and relay. However, trip temperature of the overload relay device must be near the maximum allowable temperature or the curves will be too divergent.

The effective ambient temperature for the relay enclosed with other heat generating apparatus will be higher than if mounted in the open and it is necessary to compensate by re-rating the heaters. The NEC requires application of overload trip protection at a maximum of 125 per cent of full load motor current for 40 C open motors.

The minimum limit is a heater to carry maximum full load current requirements to operate the load. This usually results in application of heaters of somewhere near a minimum of 110 per cent of the rated full load current, which gives about a 12 per cent range of motor current for one particular heater size. Change in cross-section area for each wire gage size (plus the small change in length) gives a change of resistance and a resultant current rating of about the same percentage. Thus the change in rating between heater sizes is about 12 per cent.

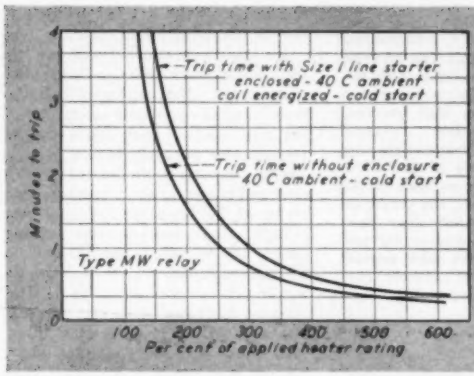

Trip time with Size I line starter enclosed - 40 C ambient coil energized - cold start
Trip time without enclosure 40 C ambient - cold start
Type MW relay
Minutes to trip
Per cent of applied heater rating

Fig. 3—Tripping time is affected by the enclosure and by the other heat generating equipment, such as starter coil and contacts, in it. These variations may be compensated for by judicious selection of the thermal element size

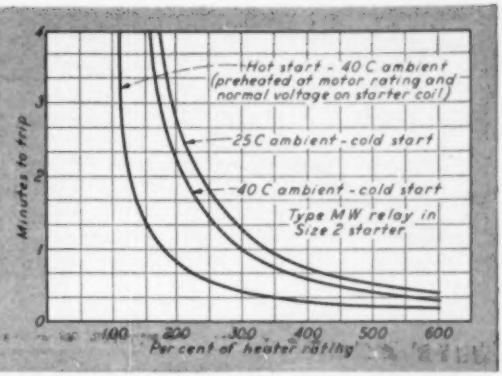

Hot start - 40 C ambient (preheated at motor rating and normal voltage on starter coil)
25 C ambient - cold start
40 C ambient - cold start
Type MW relay in Size 2 starter
Minutes to trip
Per cent of heater rating

Fig. 4—These characteristics indicate the range in trip time that may be expected from a given enclosed starter with thermal overload protection. Thermal capacity of the starter has more initial effect than ambient temperature

AND MOTOR PROTECTION

the like. Although intended for control engineers*, these fundamentals apply in most industrial plant motor controls

D. L. PIERCE, *Motor and Control Division*
Westinghouse Electric Corporation

With relays designed for tripping temperature near to the maximum allowable motor temperature, the result is approximately ¾ per cent change in basic trip current for each degree change of ambient temperature. Therefore, if a relay is applied in an enclosure with an air temperature rise of 15 C at the overload level, heater trip current will change approximately 11 per cent and the heater should be one size larger than for open air.

Enclosures Alter Ambients

In very small enclosures, as common on Size 1 starters where input-heat ratio is large, internal air temperature may be as high as 30 C above the outside ambient and it is necessary to jump two heater sizes in application. Where starters and motors have ambients which differ, the same principle applies. If the starter ambient is about 15 C below the motor ambient use a size smaller heater. If the motor ambient is about 15 C below that of the starter, one size larger is in order.

For these conditions, suitable application tables are usually available and specified for particular sizes of starters.

Relay ambient temperature and use of enclosures affect tripping time characteristics of uncompensated thermal overload relays. A change in ambient temperature alone shifts the whole curve by multiplying all current ordinates by a temperature factor. An enclosure containing heat generating apparatus modifies shape of the curve by superimposing effect of simultaneous change in the air within the enclosure. Usually, heating time of the enclosure is much longer than for the relay itself and, consequently, has the same effect as if a considerable mass were added to the relay.

Fig. 2 shows the tripping time characteristics of an open relay from a 40 C ambient without enclosure, and Fig. 3 shows the effect of applying it in a No. 1 starter enclosure. Fig. 4 compares the enclosed relay tripping from a cold start and from a hot start with all of the starter parts and enclosure preheated by operation at motor rating, as well as tripping from a cold start at a 25 C ambient.

Often motors drive inertia loads, and a standard relay and heater does not allow sufficient tripping time for the load to come up to speed. In the basic design, tripping time must be short enough to give overload and locked rotor protection to standard motors. When longer times are required, saturating inductive shunts or saturating current transformers are easily used.

The saturating inductive shunt is a small, iron core reactor to be connected in parallel with the heater. At heater rating, potential drop across the heater is below saturation voltage of the reactor and only a very small current is diverted. But at high over-currents, the reactor saturates, shunts more current and correspondingly increases trip time. Usually in application, heater current will be approximately between limits of 350 and 475 per cent for 600 per cent line current when applied in enclosures.

Fig. 5 shows the effect of a shunt reactor on heater current.

Intermittent Loads

It is common to apply thermal overload relay heaters to intermittent rated motors or continuous rated motors which may be applied to a cycling load. This can be done, but satisfactory protection can be obtained only if the heater is selected for the continuous rating of the motor.

However, maximum intermittent horsepower that can be used safely is greatly limited. Motors applied to intermittent loads on the basis of motor intermittent rating, or to intermittent loads at higher than rated horsepower on the basis of continuous rating, cannot be effectively protected by thermal overload relays.

Fig. 6 gives cyclic heating curves for a motor and an overload relay. The lower saw-toothed curve is for a

*From a paper presented at the 1952 Annual Machine Tool Electrification Forum sponsored by Westinghouse Electric Corp.

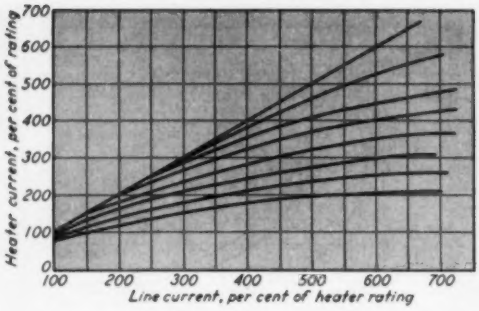


Fig. 5—Saturating inductive shunts paralleled with the heater elements bypass high starting currents, raising right end of the trip curve to give more time on high inertia loads. The curves at the left show how the heater current varies with degree shunt saturation

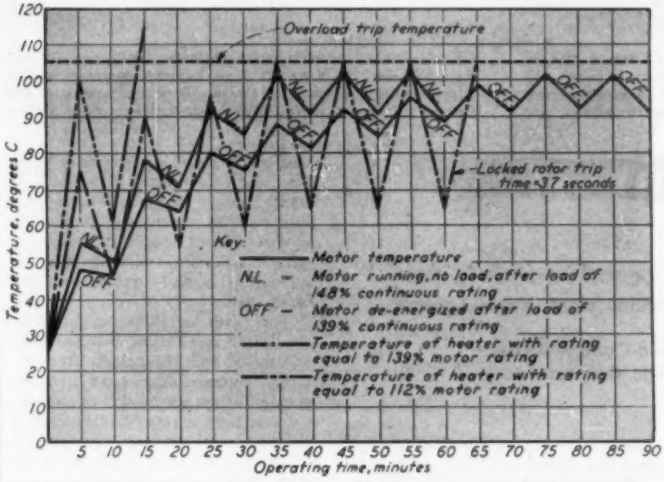

Overload trip temperature
Locked rotor trip time=37 seconds
Key:
Motor temperature
NL — Motor running, no load, after load of 148% continuous rating
OFF — Motor de-energized after load of 139% continuous rating
Temperature of heater with rating equal to 139% motor rating
Temperature of heater with rating equal to 112% motor rating
Temperature, degrees C
Operating time, minutes

Fig. 6—Motor temperature on intermittent overload cycles levels off to a value equivalent to a lower continuous load. Heater temperatures fluctuate more widely and prevent selection of a size that will provide both overload protection while running and locked rotor protection when motor is stalled

No. 284 frame motor applied on 139 per cent, full load current for 5 min "on", and 5 min "off" (de-energized), after which the cycle is continuously repeated. Maximum temperature the motor will attain is 100 C. This represents an intermittent rating of 139 per cent of continuous rating which could be given to this motor for this particular duty cycle.

The curve just above that for the 139 per cent load is for the same motor applied at 148 per cent load on a duty cycle of 5 min full load and 5 min no load (energized and running), continuously repeated. Although maximum motor temperature is about 103 C, it is fairly close to stabilizing at about the same temperature as for the previous loading. Under this last condition, the rating could be 148 per cent of the continuous value.

To have locked rotor protection for this motor, the overload relay heater should be applied for the continuous rating. If it is assumed that it is selected for 112 per cent of full load motor current, it would be a representative application for heaters normally applied up to 125 per cent.

Based on the 112 per cent full load motor current and using the motor overload of 139 per cent for the intermittent rating, heater current would be 125 per cent *of its own rating* during the load cycle.

The top curve shows the overload relay heating and cooling curve for load current at 125 per cent heater rating. At the end of the first 5 min load period, the trip element has reached a temperature of 100 C. The next 5 min shows it cooling without load down to 60 C, and during the next 5 min under load, the element would attain a temperature of 114 C. In doing so, however, it passes the 105 C overload trip temperature and takes the motor off the line before completion of the second load cycle.

To apply a heater that will not trip out on the load cycles, a larger size is necessary. The smallest which can be selected is one whose rating is 139 per cent of full load motor current (equals 100 per cent heater rating). The heating and cooling curve for this relay and heater is shown superimposed on top of the two motor curves. It was plotted from heating and cooling curves of measured temperature on the bimetallic disc which trips the relay. It will be noted that after 35 min, the relay has come up to trip temperature and will remain at this value. This heater is the very smallest which may be applied, for it is on the verge of tripping on the 139 per cent load cycle.

However, this overload relay will not trip in the required time for protection of the motor on locked rotor. The trip time of the heater and relay combination on this motor is 37 sec, because it was necessary to apply a much larger size to carry the intermittent motor load.

This heater application will carry running over-current protection to this motor on the duty cycle shown. It is possible to match relay heaters to almost any condition of running duty cycle and heating as has just been done, but not simultaneously to obtain locked rotor protection.

Effect of Open Phases

If one phase of a three phase circuit supplying an induction motor is open, current in the relay as well as in the motor windings will depend on the particular conditions. In a delta-connected motor, currents in the overload relay may not change by as great a percentage as those through the motor winding, so the protection afforded by the relay may be less than under three phase conditions.

Fig. 7 shows conditions which can exist with an open phase on both a wye-connected and a delta-connected motor. It is assumed that horsepower output is constant when the motor is running and that parallel currents divide in an inverse ratio to the impedances. Normal full load current through the overload relay heater under normal three phase conditions is designated by *a* and *A* indicates the the locked-rotor current. Current in the motor winding is designated by *b*. Currents to be expected with the circuit open at *x* or *y* are indicated by the numerical values in the diagram.

The table shows tripping time under various conditions of single phasing, and for comparison, also gives time to trip under three phase operation with the same motor currents. The values

given are based on a relay built approximately in accordance with the maximum allowable 600 per cent, full load current trip time as covered by the Underwriters Laboratories' standards. Curves shown previously are for a relay which has a considerably shorter time than the allowable maximum, and under two minutes, trip time would be only about two thirds of the value shown in the table.

If a phase opens while the motor is running fully loaded, the motor is apt to stop. The current then increases to locked rotor values, and the relay, having been preheated with the normal currents, will trip in much shorter time than those given. In some cases, although the motor continues to run, it will be near pullout, slip will be high, and the currents much higher than indicated. The ratios of relay and motor currents, however, will be approximately the same.

Single phasing can occur also as a result of a blown fuse or other conditions in the primary power transformers. This has been recognized recently by the NEC, and the code has changed to stipulate where three pole overload relay protection is required. It has become important since the last war because many power companies have changed from delta-delta power transformer connections to wye-delta to increase capacity of their systems.

Transformer Connections

On a delta-delta power transformer connection, an "open" in one primary phase results in single phase operation of both the primary and secondary, and motor conditions become the same as if single phasing occurred in the secondary circuit. This is not true on a wye-delta power transformer circuit.

A wye-delta transformer connection "open" in one primary line has two primaries in series on a single phase, Fig. 8. In the delta secondary, one transformer leg is inactive, and two transformer legs act individually, but with parallel, in-phase voltages induced in their respective circuits, one line carrying the sum of the currents in the other two lines. With a wye-connected motor, one winding will have approximately twice the current of the other two. If, with a two pole relay, this current is carried by the line in which there is no heater element, the motor will be greatly underprotected.

In a delta-connected motor, two windings only will be energized, and one line will carry their sum. If a relay element is in this line, the motor will be protected. But with elements in the other lines, the current carried by the relay heaters is the same as in the motor windings. Inasmuch as heaters are selected on the basis of line current equal to 1.73 times the delta current, the motor will not be adequately protected. In the running motor, generated voltage in the windings somewhat decreases current unbalance, but the corrective effect decreases with increasing load and is practically unimportant when operating at full load. At full load, slip will generally increase to near pull out, and the currents will be considerably above these indicated in the drawing.

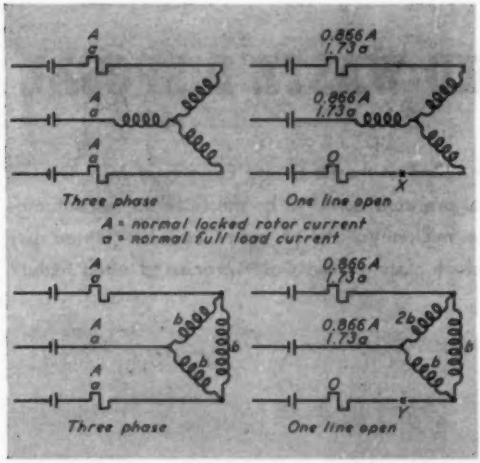


Fig. 7—Ratio of currents for normal three phase and for "single phasing" operation is shown for full load current, a, and locked rotor current, A, with leads open at x or y. Tripping times for a typical heater are given in the table

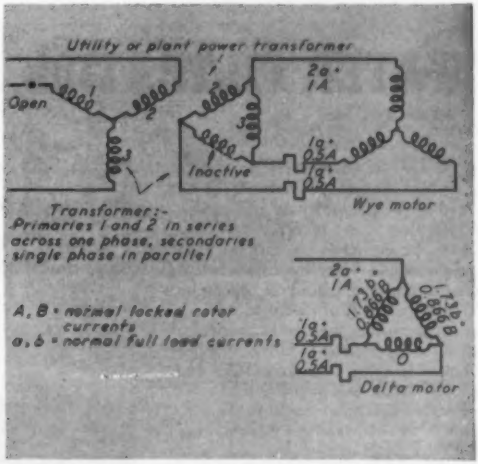
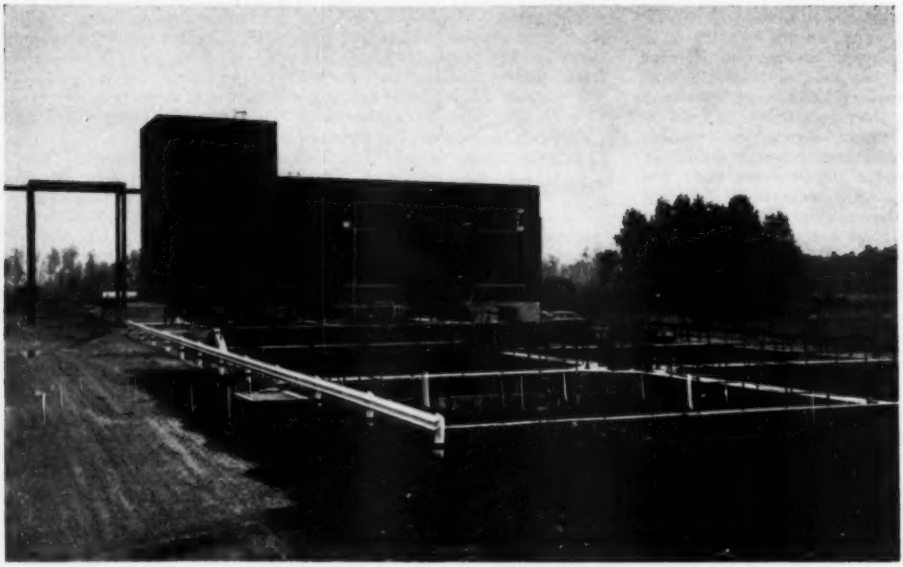


Fig. 8—Many power companies have recently changed to the wye-delta connection in their transformers, allowing single phase primary operation to be reflected in secondary circuits, and making two pole protection for motors inadequate

COMPARATIVE MAXIMUM CURRENTS, TRIP TIMES FOR SINGLE PHASE CONDITIONS, FIG. 7

Motor type	Motor load	Operating condition	Motor current, per cent of full load	Heater current, per cent of heater rating	Single phase trip time, sec	Three phase trip time, same motor current, sec
Wye	100%	Lead open at X	173	138	320	320
Wye	Locked	Lead open at X	520	417	44	44
Delta	100%	Lead open at Y	200	138	320	320
Delta	72%	Lead open at Y	143	99	No trip	1200
Delta	Locked	Lead open at Y	600	417	44	36



This building houses the center of activity of the new water treatment and waste disposal unit at Ford

WATER FILTRATION AND WASTE DISPOSAL

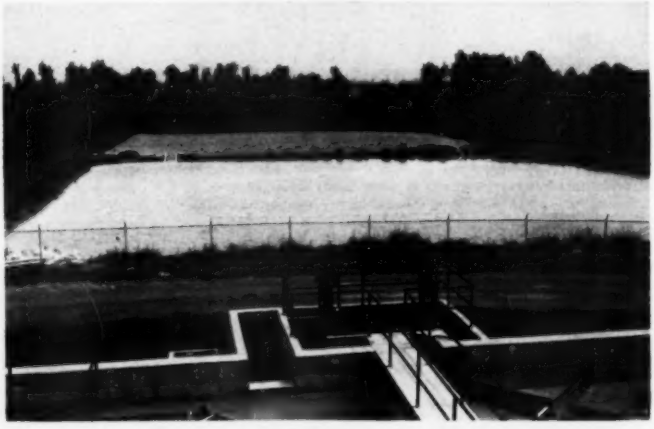
Systems recently installed at the Parts and Equipment Mfg. Div. of the Ford Motor Co. are considered to be the finest in the automotive industry. Four million gallons of water can be filtered per day, and 1000 gal of plating rinse water processed each minute

SINCE the Parts and Equipment Manufacturing Division of the Ford Motor Co. took over and converted the plant it now occupies at Monroe, Mich., an entirely new unit for water treatment and waste disposal has been constructed and placed in operation. This is the result of extensive research, and the unit is among the finest and most modern in the industry. Water is pumped to this unit from Lake Erie and is chlorinated, softened, and filtered before being delivered to the plant proper for manufacturing operations.

Water pumped from the lake enters the treatment tanks, is chlorinated, clarified, and softened before entering the building to the filters. Four conventional rapid sand filters rated at one million gallons per day each are employed. This type treatment is practiced throughout the country in city water plants.

Either split treatment or selective lime softening may be utilized. Split treatment is accomplished by over treating 75 per cent of the raw water with lime, to precipitate the magnesium, and then mixing with the remaining 25 per cent for stabilization and clarification before filtration.

Selective lime softening is done by



These two sludge lagoons have a capacity of about 150,000 cu ft and are just a part of the new water filtration system and waste disposal plant at Ford

removing the suspended solids (turbidity) in the primary clarifier and softening in the secondary unit before filtering.

After use in the manufacturing plant, which includes a large plating installation, the water must be treated to remove the toxic substances. It is then pumped into the Raisin River, which flows close to the plant and empties into Lake Erie. Both cyanide and chrome are used in the plating operations and require treatment before discharge.

Alkaline chlorination method is used for cyanide destruction. The cyanide is oxidized to carbon dioxide and nitrogen by maintaining a pH of about 9 with lime. Chlorine is fed to the waste until a free chlorine residual is obtained.

Chromium wastes are treated by reducing the chrome from the hexavalent to the trivalent form with sulfur dioxide and precipitating it as chromium hydroxide with lime. The chromium treatment plant consists of four 200,000 gal holding tanks, acid proofed with Ceilcrete, two reaction tanks, and two up-flow type clarifiers. These clarifiers are the same type that are used for the water treatment process. Both cyanide and chrome wastes are treated on a batch basis.

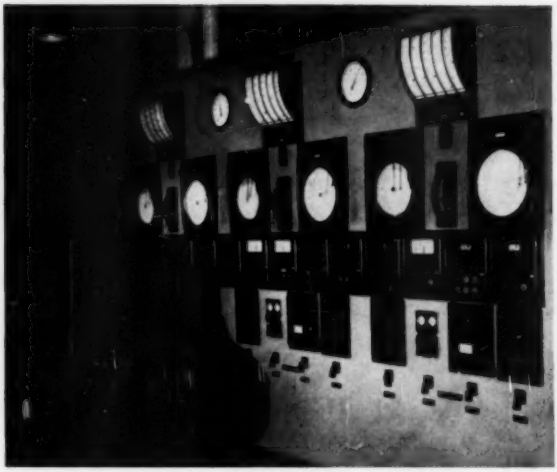
Some of the advantages of combining the two operations are: use of a common building, laboratory, chemical storage, sludge lagoons, and personnel to operate both portions of the plant. Statistics on this installation show the sludge lagoons hold about 150,000 cu ft and the water plant would supply a city with a population of 40,000.

Water pumped from Lake Erie enters these clarifiers before being discharged into the main filter beds

Concrete tanks, in foreground, receive waste water from manufacturing operations. Water is treated to make it non-toxic before discharging into the Raisin River

Isaac Cox, supervisor of Ford's new water filtration and waste disposal plant, operates the master control board

Tests are run on waste water specimen to determine what types of chemicals are required to remove toxic materials



These controls operate spreader stokers during winter months and gas burners in summer on three 25,000 lb per hr generators

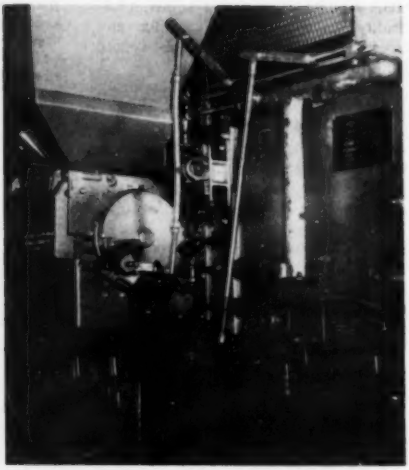


Photo shows power unit which regulates the stoker to proportion fuel feed to air flow

AUTOMATIC COMBUSTION CONTROLS FOR SPREADER STOKERS

Spreader stoker fired boilers are designed to operate with only a limited supply of fuel in the furnace. Response to load variations is extremely fast, and automatic control of fuel feed and air flow is required to maintain constant pressure and maximum efficiency

WILLIAM H. PUGSLEY
Vice President in Charge of Field Research
The Hays Corporation

ALTHOUGH the method of burning fuel employed by spreader stokers has been used to some extent for many years, recognition of the merits of the method and application of this type stoker has been greatest in the last few years. By using specially designed grates with improved feeders, modern spreader stokers produce decidedly better results than those secured with the earlier types.

Spreader stokers utilize methods different than those used by other stokers for: (a) feeding fuel into the furnace and distributing it on the grates, (b) controlling air distribution, and (c) removing ash from the grates. These functions are performed by two separate parts of the stoker, namely: (a) coal feeding and distributing unit, and (b) grates and air distribution system.

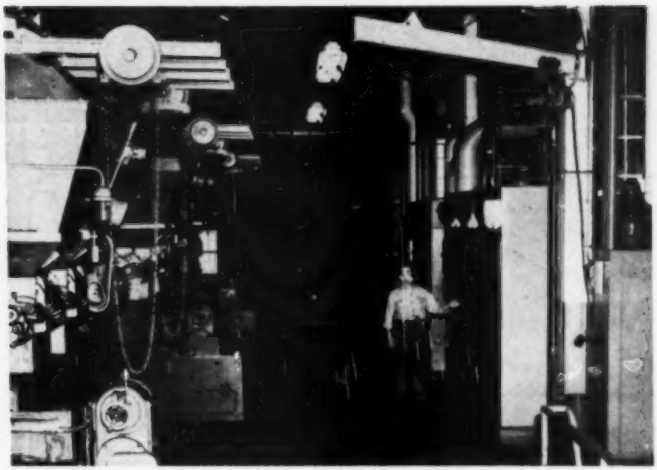
Essentially, the coal feeding and distributing unit starts with a hopper from which coal falls by gravity into the feeding mechanism. Here a fuel pusher moving back and forth at uniform frequency forces coal toward the furnace along a distribution plate. The length of the fuel pusher stroke can be varied either manually or automatically through the linkage and lever provided and this adjustment determines the quantity of fuel being fed into the furnace.

Fuel Distribution

Coal pushed toward the furnace moves along a manually adjustable feeder or fuel distribution plate. The position of this plate in relation to the rotor of the feeder determines the distribution of fuel lengthwise on the grates. As coal falls off the edge of the feeder plate, it drops into contact with a constantly revolving rotor. This rotor is fitted with blades which, because of their shape, throw coal into the furnace to cover the grates evenly over their entire width. Some of the fine fuel particles burn in suspension while larger particles fall and are burned on the grates. Some stokers are arranged to feed fuel to the furnace pneumatically.

Generally, each feeder unit is provided with a combustion chamber door directly beneath the feeder at grate level for inspection, cleaning of fires or hand firing in an emergency. Each feeder also has an ash pit door below the combustion chamber door. Several feeders may be used for one steam generator and in this case, grates and windbox are divided. Each feeder throws coal on a separate grate section with air being supplied to that section through an individual manually operated damper.

Several types of grates such as stationary, hand operated dumping, and power operated dumping are available. In addition, another type consisting of bars with holes in them formed into a chain which moves at a uniform rate can be applied when continuous ash



Firing aisle of this modern power plant has three steam generators at left and automatic combustion control system and instrumentation panel at right

discharge is desired. Openings permitting air to pass through the grates are usually of the small or pinhole type, or of some special design. The large number of these grate openings reduces air flow resistance and provides even air distribution to the fuel. Each feeder usually receives an additional supply of air at several inches of water pressure to cool the feeder parts. This air flows into the furnace as overfire air to help support combustion.

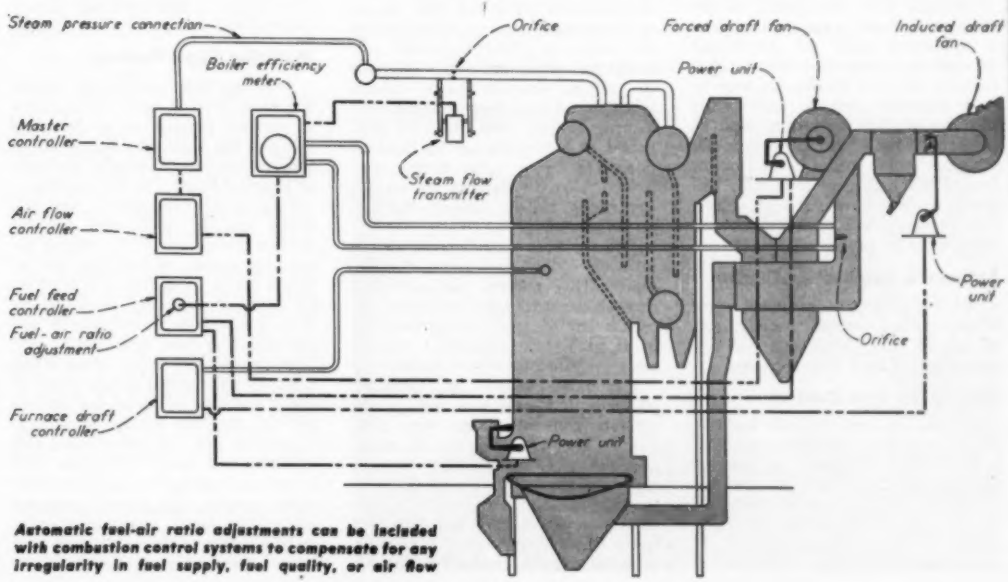
After a quantity of coal is burned, the ash must be removed. Before removing the ash the fuel feed is stopped, and the small amount of fuel on the grates at the time is burned out. Then ash is removed by hand or by operating the dump grates. If continuously moving type grates are used, fuel feed need not be stopped as ashes are removed automatically.

In operation, fuel is thrown evenly into the combustion chamber where fine particles burn in suspension while larger pieces of coal fall and are consumed on the grates. Since the grates are flat, the fuel bed is likewise flat and thin, and about three minutes' fuel supply is the most that is on the grates at any time. Volatiles are distilled by the heat from the fine particles burning in suspension while fixed carbon burns on the grates through which air is passing, both processes taking place simultaneously. When all combustible in the fuel has been consumed the ash which is left remains on the grates until it is dumped or otherwise removed.

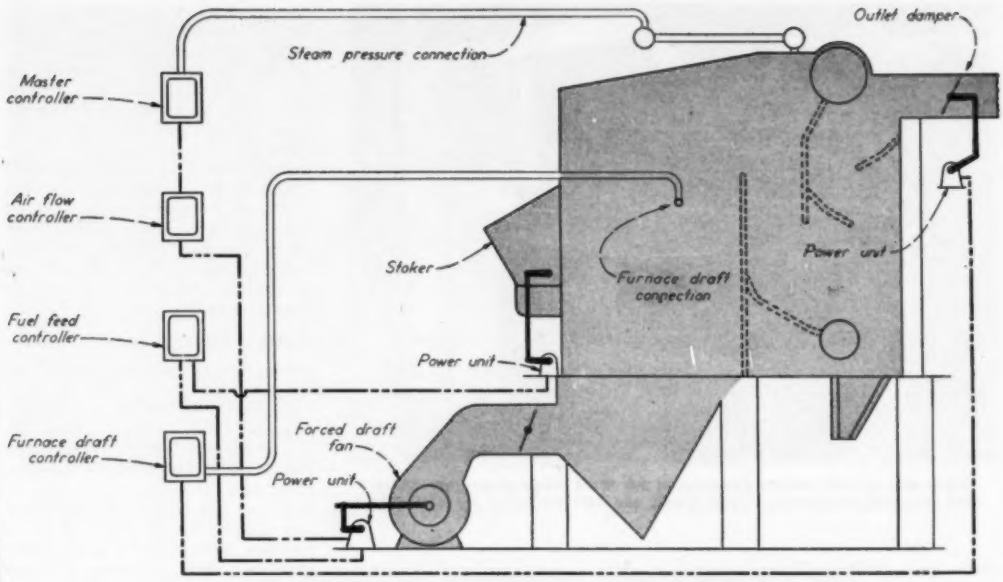
Control Requirements

Since a comparatively uniform burning rate of both volatiles and fixed carbon in the fuel takes place over the entire fuel bed, air flow rate through the grates and fuel is also uniform. Maximum combustion efficiency is secured only when the correct rates of fuel feed and air flow are maintained and distribution of fuel and air is complete and uniform over the entire grate area. It is, of course, necessary to have sufficient temperature for combustion to take place, time for it to be complete, and turbulence for mixing the air and gases.

To hold steam pressure constant, fuel feed and air flow rates must be proportional to the load. Furthermore, the ratio of fuel and air must be correct to maintain uniform combustion efficiency. Lack of air may cause smoke or CO in the flue gas while too much



Automatic fuel-air ratio adjustments can be included with combustion control systems to compensate for any irregularity in fuel supply, fuel quality, or air flow



Schematic drawing shows typical remote positioning type combustion control system designed for boilers with stokers and individual constant speed forced draft fans

air causes low CO_2 and loss of efficiency. The small amount of fuel in the combustion chamber at any time and the rapidity with which it burns make accurate control of both fuel and air important. As a change in the fuel supply almost immediately changes the CO_2, both air flow and fuel feed should be controlled automatically.

Uniform fuel distribution in the combustion chamber and on the grates is important, since air distribution through the grates is uniform. Adjustment for fuel distribution must be made manually, and for each quality and size of fuel the setting must be checked. If the adjustment is such that too much fuel is spread to the front or rear of the grate, uniform CO_2 will not be produced from the entire fuel bed, efficiency will be impaired, and smoke may be produced.

Automatic Combustion Control

All three types of automatic combustion control systems, namely: (a) off and on, (b) positioning, and (c) metering, are used with spreaders.

Off and On Type Control

Off and on type controls are employed only for very small steam generators. These systems do not produce very good efficiency, will cause smoke due to the deficiency of air while the forced draft is off, and are quite apt to allow the fire to go out if the off period is of long duration.

Positioning Control

Positioning control systems, especially the remote type, are well suited to application for all sizes of steam generating units and give satisfactory results. This system of control consists of a master steam pressure controller which responds to changes in steam pressure and, by means of power units, actuates the forced draft damper to control air flow rate and the lever on the stoker to adjust fuel feed rate. Steam generating units with this type of control generally have constant speed forced draft fans equipped with dampers or inlet vanes which are positioned to control the air for combustion. The boiler outlet damper may be controlled to regulate the air for combustion, but the former is the preferred method.

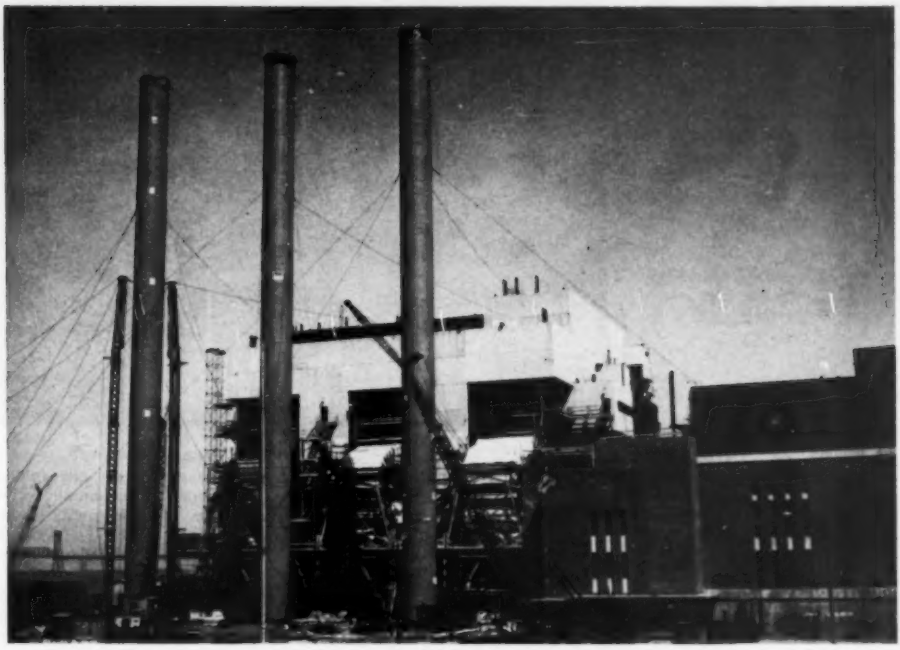
Furnace draft controllers are used to maintain a low combustion chamber draft. This reduces air infiltration through the setting to a minimum and retards any tendency for fly ash and small particles of unburned fuel to carry over into the boiler passes.

Positioning systems of automatic combustion control will hold steam pressure constant within very close limits. They are calibrated to maintain desired air-fuel ratios through proper alignment of levers and connecting linkage between the power units and the damper and fuel feed levers which they operate. Variations in arc of angular travel of power unit levers and damper or fuel feed levers are used to compensate for the movement characteristics of the fuel feed and air damper control levers. In addition, the system can be provided with a convenient means for manual operation from a central point. This may be utilized for changing distribution of load between boilers and making adjustments in fuel feed rate to compensate for changes in fuel quality.

Metering Type Control

Metering type combustion control should be used if air is not available at constant pressure or if fuel feed rate and Btu input vary widely due to different sources of supply, moisture, or irregular sizing. If only air flow is variable, a metering type air flow controller can be substituted for the damper control unit in the remote positioning system. If both fuel and air vary, a system of control in which fuel-air ratio is readjusted from the air flow—steam flow relationship is recommended as most desirable.

Automatic combustion control is justified in the modern power plant of small, medium or large size because its use provides benefits including: (a) lower fuel and steam costs, (b) improved operating conditions, (c) better use of manpower, (d) maximum steam capacity, (e) greater operating safety, (f) better service continuity, and (g) reduced fly ash, carryover of coke, and formation of clinkers.



These three steel stacks, at Pacific Gas and Electric Co., were guinea pigs in vibration tests

LINED STEEL STACKS . . . .

. . . show great resistance to vibration caused by constant wind. Special lining, consisting of insulating concrete, in the stack dampens the harmonic energy and reduces the vibration amplitudes

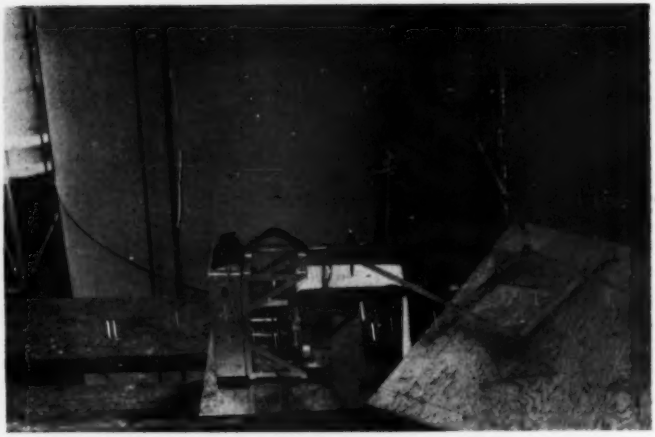
GEORGE F. BURNLEY, ***Consultant***

PRIOR to the erection of a pair of 16.5 ft ID x 200 ft smoke stacks and subsequent to the installation of six 11.5 ft x 200 stacks, Bechtel Corp. in conjunction with Pacific Gas & Electric Co. engineers completed a series of exhaustive tests concerning the effectiveness of Gunite lining in resisting wind vibration.

Stacks in question are part of the huge and costly expansion program of the Pacific Gas & Electric Company's Contra Costa Steam Power Plant at Antioch, Calif. The job site is located on the Sacramento River and is directly exposed to the steady winds of the flat delta country that prevail for weeks at a time.

According to study and estimate, the constant pressure of air moving past opposite sides of a cylindrical surface, such as a stack, causes high and low pressure areas to be built up on the sides and at right angles to the wind direction. They peel off from one side and then the other forming vortices. The rate at which these vortices are shed from the cylinder varies and de-

Cables were connected at the top of the stack. The stack was placed under bending tension and the top deflected 8 in. The cable was then suddenly released



Recording devices, in foreground, were employed to obtain data. Pantograph rigging can be adjusted to cause trace to be in proper scale for the chart

pends on wind velocity and stack diameter. When the frequency of these alternating forces matches the natural frequency of vibration of the stack resonance occurs, and the virbration increases to an alarming amplitude. Gunite is added inside the stack as a dampening medium, which absorbs this energy. This also prevents increases in vibration amplitudes, which might become larger and larger until the stack fails.

With these matters in mind, a full scale test was made on the 11.5 ft diam steel stacks immediately upon erection and prior to lining. For the test, a steel cable was attached to the top, and the stack was deflected 8 in. and suddenly released. Readings of meters and instruments were recorded. The same test was repeated after the stacks were lined. A final comparison of details gave conclusive evidence that the lining aided greatly in dampening and resisting vibration.

As further evidence, engineers of Bechtel Corp. and P. G. & E. experts built a scale model of these stacks and conducted wind tunnel tests, which substantiated earlier tests and complex mathematical analyses.

Concerning the characteristics of the lining, laboratory experiments indicated that the continual strains, which the material would go through within the stacks, should cut down resiliency thus making it even more effective as a dampening agent as time progressed.

Specifications call for the lining to be of lightweight material consisting of a dry mixture of one volume of cement and five volumes of Haydite aggregate. The aggregate is to be graded from 3/16 in. maximum to fine so as to produce an insulating concrete weighing approximately 110 lb per cu ft. Lining will be 3 in. thick from the top to the breechings 32 ft from the bottom. At this point the thickness will taper down to a final 8 in. base.

AIR LEAKS IN PRODUCTION LINES COST MONEY

MAXIMUM benefits are obtained by keeping a close vigilance over air systems. Conversely, where reasonable maintenance is not conducted, a loss in production and dollars is experienced. One of the greatest production robbers is low pressure.

When pressure at a pneumatic tool falls from 90 to 70 psig, production output of that tool may drop as much as 35 per cent. Somewhat more specific are air motors, which are used extensively to power air tools and other pneumatic devices. Because compressed air systems in most plants utilize pressures between 90 and 110 psig, air motors are designed to operate within those working pressures. An air motor, built to operate at 90 psig, however, will lose 25 per cent of its capacity when air pressure is 70 psig.

First inclination, when air pressures drop, may be to place the blame on insufficient compressor capacity. Checking the air distribution system, first, may save the cost of new compressor equipment. One principal cause of low-air pressure is a leaky distribution.

Checking the air distribution system for leaks is a relatively simple matter. Results have proven that the most likely location is around valve stems, hose connections, unions, drains, homemade blow guns, and lines leading to inoperative tools. Of course, the entire system should be checked with particular attention to lines subjected to unusually rugged treatment. This inspection should be made monthly.

Plant maintenance departments have come up with many simple and rather unique ways to check leaks. Most frequently used are the lighted candle or the solution of soapy water, which is brushed around suspected areas. One manufacturer puts essence of peppermint into the air system. Detection of the slightest leak is by odor. Still another method, rather ingenious, employs a small siren-like whistle. When the device is passed over the lines, escaping air causes the siren to operate.

Some of the leaks may be very small, appearing trivial in themselves. But, such leaks may be numerous and have a high accumulative effect. Actually, these leaks spell a very definite dollar loss as shown in Table 1. This dollar and cents wastage more than justifies scheduled maintenance.

TABLE 1—COST OF AIR LINE LEAKS

Opening, Inches	Air lost, cu ft per month (based on 100 psig and 0.65 orifice)	Cost of air lost
3/8	6,671,890	467.03
1/4	2,920,840	204.46
1/16	740,210	51.81
1/8	182,272	12.75
1/32	45,508	3.19

CALCULATION OF COMPARABLE HEAT RATES OF STEAM TURBINES

Turbine heat rate is an important consideration for any industrial nonprocess steam power plant as it establishes fuel consumption. This article details methods for calculating comparable data with different initial steam conditions thereby permitting determination of the most economical design for the requirements of a specific plant

E. V. POLLARD, ***Section Engineer***
Turbine Engineering Division
General Electric Company

TURBINE HEAT RATE is a criterion of fuel economy for a nonprocess steam power plant. Thus, what steam conditions are most economical is a basic question in any new power plant study. This article furnishes a convenient method for calculating comparable turbine heat rates and other fundamental information with different steam conditions.

The following method starts with nonextraction steam rates of a selected turbine rating at given sets of steam conditions and proceeds through logical steps with the aid of curves to establish the following information:

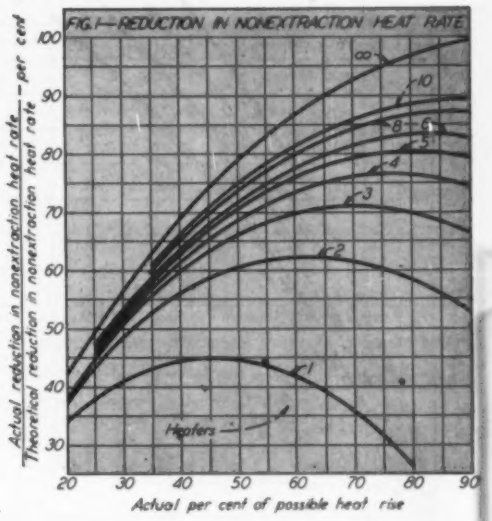
Part 1
a. Heat rates at 4/4 load
b. Throttle flows at 4/4 load
c. Condenser flows at 4/4 load

Part 2
a. Estimated extraction flows to heaters
b. Estimated feedwater temperatures

Part 3
a. Heat rates at fractional loads
b. Throttle flows at fractional loads
c. Condenser flows at fractional loads
d. Estimated feedwater temperature

Each method is followed by a numerical example. This furnishes a convenient reference for the occasional user, as it indicates magnitude of each item.

Individual heat rates as derived may or may not be the correct value as this article is interested only in the difference in heat rate for similarly designed turbines when each is designed for a different group of steam conditions. The difference in heat rate is essentially correct and is satisfactory for the



PART I — DERIVATION OF COMPARABLE HEAT RATES, THROTTLE FLOWS, AND CONDENSER FLOWS AT 4/4 LOAD

Line	Symbol	Source	Description
1	P_1	Given	Initial pressure, psig
2	T_1	Given	Initial temperature, deg F
3	P_F	Given	Back pressure, in. Hg absolute
4		*See references	Nonextraction steam rate, lb per kwhr
5	H_0	At 1 and 2	Initial enthalpy, Btu per lb
6	h_f	At 3	Enthalpy of liquid at back pressure, Btu per lb
7		5 − 6	Nonextraction heat added in boiler, Btu per lb
8		4 × 7	Nonextraction heat rate, Btu per kwhr
9		At 1	Enthalpy of liquid at inlet pressure, Btu per lb
10		9 − 6	"Possible" heat rise of feedwater, Btu per lb
11		Select	Number of heaters
12		Fig. 1 at 11	Optimum per cent of possible heat rise
13		Use 0.8	Fraction of optimum per cent of possible heat rise
14		12 × 13	Actual per cent of possible heat rise
15		10 × 14/100	Actual heat rise of feedwater, Btu per lb
16	h_f	6 + 15	Final enthalpy of feedwater, Btu per lb
17		Fig. 3 at 16	$t - h_f$
18	t_f	16 + 17	Final temperature of feedwater, deg F
19		Fig. 1 at 14	$\frac{\text{Actual reduction in nonextraction heat rate}}{\text{Theoretical reduction in nonextraction heat rate}}$, per cent
20		Fig. 2	Theoretical reduction in nonextraction heat rate, per cent
21		19 × 20/100	Actual reduction in nonextraction heat rate, per cent
22		8 × 21/100	Actual reduction in nonextraction heat rate, Btu per kwhr
23	HR	8 − 22	Heat rate with feedwater heating, Btu per kwhr
24		5 − 16	Heat added in boiler, Btu per lb
25	F_T	23 × Load/24	Throttle flow with feedwater heating, lb per hr
26		1 × 1.25	Pressure of feedwater leaving boiler feed pump, psia
27		Fig. 6 at 26 and 250 F	Isentropic work of liquid compression, Btu per lb
28		Given	Boiler feed pump efficiency, per cent
29		25 × 27/28 × 3413	Input to boiler feed pump, kw
30		Use 0.7	Net effectiveness of boiler feed pump work, fraction
31		23 × 29 × 30/Rating	Increase of heat rate due to boiler feed pump work, Btu per kwhr
32	HR	23 + 31	Heat rate corrected for boiler feed pump work, Btu per kwhr
33	F_T	32 × Load/24	Throttle flow with feedwater heating, lb per hr
34		Fig. 4 at 15	Total extraction as per cent of throttle flow
35		33 × 34/100	Total extraction, lb per hr
36	F_C	33 − 35	Condenser flow, lb per hr

If final temperature of feedwater is assumed, solve lines 14 to 17 in reverse order.

If boiler feed pump work is not considered, lines 26 to 31 inclusive may be omitted and lines 32 and 33 will be the same as 23 and 25 respectively. In this case, boiler feed pump input is included in the auxiliary losses of the power plant.

Fig. 1 and 2 have been reproduced by permission from "Steam Turbines and Their Cycles" by J. Kenneth Salisbury, John Wiley and Sons, New York, 1950.

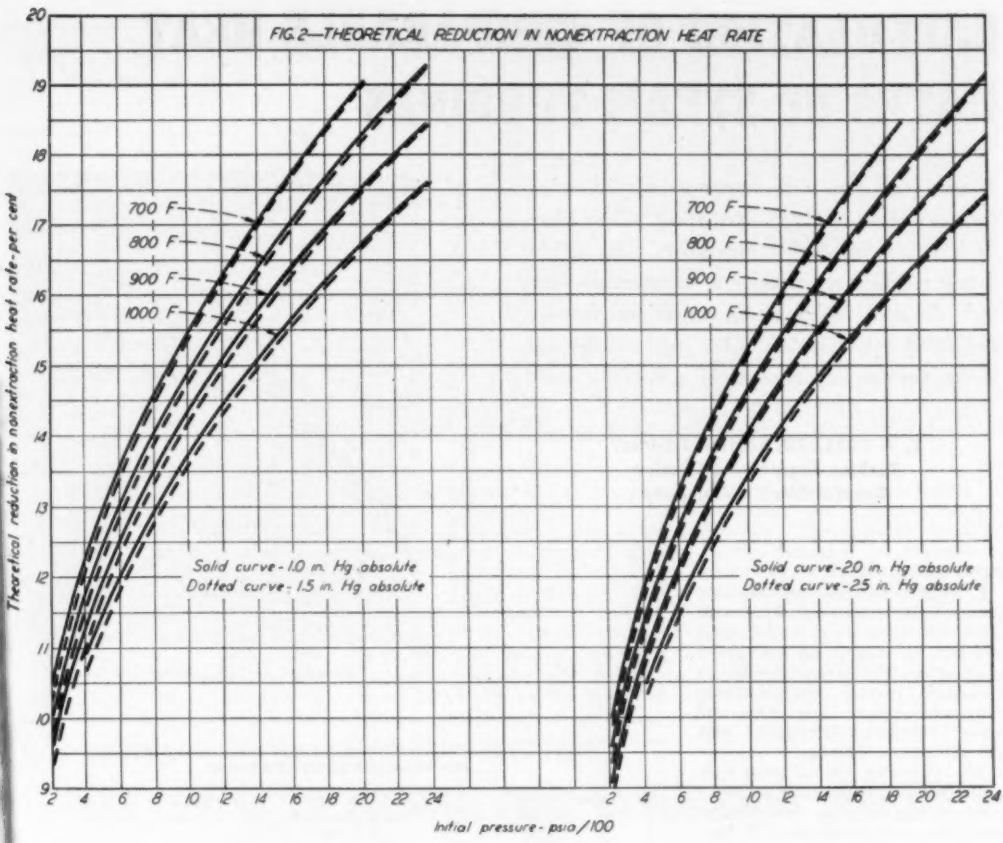


FIG. 2—THEORETICAL REDUCTION IN NONEXTRACTION HEAT RATE
Theoretical reduction in nonextraction heat rate-per cent
700 F
800 F
900 F
1000 F
Solid curve-1.0 in. Hg absolute
Dotted curve-1.5 in. Hg absolute
Solid curve-2.0 in. Hg absolute
Dotted curve-2.5 in. Hg absolute
Initial pressure-psia/100

PART 2 — ESTIMATED EXTRACTION FLOWS AND FEEDWATER TEMPERATURES

Line	Symbol	Source	Description	Example for a 10,000 kw, 60 cycle unit				
37		15/11	Heat rise of feedwater per heater, Btu per lb	56.8	64.0	64.0	71.0	71.0
38		6 + 37	Enthalpy of feedwater leaving 1st heater, Btu per lb	116.5	123.7	123.7	130.7	130.7
39		Fig. 3 at 38	t — h	32.1	32.1	32.1	32.1	32.1
40		38 + 39	Temperature of feedwater leaving 1st heater, deg F	148.6	155.8	155.8	162.8	162.8
41	s_1	36 × 37/940	Extraction to 1st heater, lb per hr	4840	4970	4690	5080	4900
42		36 + 40	Feedwater to 2nd heater, lb per hr	84,940	77,970	73,590	72,380	69,700
43		38 + 37	Enthalpy of feedwater leaving 2nd heater, Btu per lb	173.3	187.7	187.7	201.7	201.7
44		Fig. 3 at 43	t — h	32.0	31.8	31.8	31.7	31.7
45		43 + 44	Temperature of feedwater leaving 2nd heater, deg F	205.3	219.5	219.5	233.4	233.4
46	s_2	42 × 37/940	Extraction to 2nd heater, lb per hr	5130	5310	5010	5460	5270
47		42 + 46	Feedwater to 3rd heater, lb per hr	90,070	83,280	78,600	77,840	74,970
48		43 + 37	Enthalpy of feedwater leaving 3rd heater, Btu per lb	230.1	251.7	251.7	272.7	272.7
49		Fig. 3 at 48	t — h	31.3	30.8	30.8	30.3	30.3
50		48 + 49	Temperature of feedwater leaving 3rd heater, deg F	261.4	282.5	282.5	303.0	303.0
51	s_3	47 × 37/940	Extraction to 3rd heater, lb per hr	5440	5670	5350	5800	5660
52		47 + 51	Feedwater to 4th heater, lb per hr	95,510	88,950	83,950	83,720	80,630
53		48 + 37	Enthalpy of feedwater leaving 4th heater, Btu per lb	286.9	315.7	315.7	343.7	343.7
54		Fig. 3 at 53	t — h	29.8	28.7	28.7	27.2	27.2
55		53 + 54	Temperature of feedwater leaving 4th heater, deg F	316.7	344.4	344.4	370.9	370.9
56	s_4	52 × 37/940	Extraction to 4th heater, lb per hr	5770	6060	5720	6330	6090
57		52 + 56	Feedwater leaving 4th heater, lb per hr	101,280	95,010	89,670	90,050	86,720

Additional lines like lines 53 to 57 inclusive can be added for additional heaters.

Feedwater quantity leaving the last heater should check the throttle flow, line 33. It is not necessary to obtain an exact check, but they should look somewhat alike.

To find steam pressure in the heater shell, add a reasonable terminal temperature difference to the "temperature of feedwater leaving heater". This gives saturation temperature of steam in the heater, and corresponding steam pressure is then found in the steam tables.

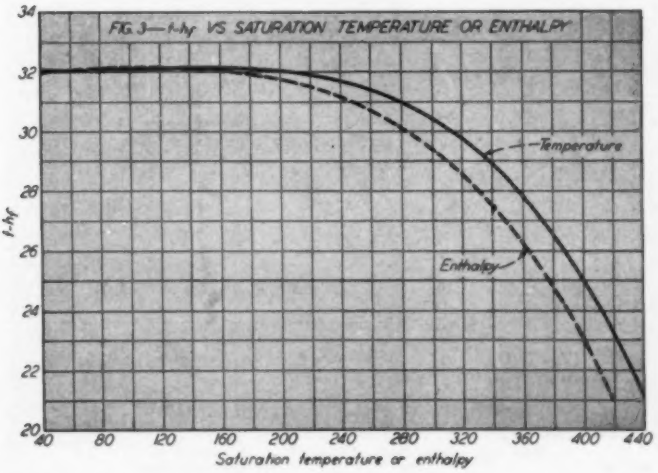
Reasonable terminal temperature differences might vary from 5 F in No. 1 heater to 12 F in No. 4 heater.

PART 3 — DERIVATION OF COMPARABLE HEAT RATES, THROTTLE FLOWS, CONDENSER FLOWS, AND FEEDWATER TEMPERATURES AT FRACTIONAL LOADS

This procedure assumes a 4/4 load heat rate calculation has been made and straight condensing steam rates at fractional loads are available

Line	Symbol	Source	Description	Example for a 10,000 kw, 60 cycle unit				
0		Given	Load, kw	2500	5000	7500	10,000	12,500
1		Given	Initial pressure, psig	600	600	600	600	600
2		Given	Initial temperature, deg F	825	825	825	825	825
3		Given	Back pressure, in. Hg absolute	1.5	1.5	1.5	1.5	1.5
4		Load/rating	Fraction of rated load, per cent	25	50	75	100	125
5		*See references	Straight condensing steam rate, lb per kwhr	10.37	9.01	8.62	8.48	8.49
6	H_0	At 1 and 2	Initial enthalpy, Btu per lb	1420.9	1420.9	1420.9	1420.9	1420.9
7	h_c	At 3	Enthalpy of liquid at back pressure, Btu per lb	59.7	59.7	59.7	59.7	59.7
8		6 — 7	Nonextraction heat added in boiler, Btu per lb	1361.2	1361.2	1361.2	1361.2	1361.2
9		5 × 8	Straight condensing heat rate, Btu per kwhr	14,120	12,260	11,730	11,540	11,550
10		At 1	Enthalpy of liquid at inlet pressure, Btu per lb	475	475	475	475	475
11		10 — 7	"Possible" heat rise of feedwater, Btu per lb	415.3	415.3	415.3	415.3	415.3
12		Given	Number of heaters	4	4	4	4	4
13		Fig. 5 at 4	"Equivalent final pressure" of feedwater, psia	31.25	62.5	93.75	125.0	156.2
14	h_f	At 13	Final enthalpy of feedwater, Btu per lb	221.2	265.2	293.5	315.7	334.0
15		14 — 7	Actual heat rise of feedwater, Btu per lb	161.5	205.5	233.8	256.0	274.3
16		15 × 100/11	Actual per cent of possible heat rise, Btu per lb	38.9	49.5	56.3	61.6	66.1
17		Fig. 1 at 12 and 16	Actual reduction in nonextraction heat rate / Theoretical reduction in nonextraction heat rate, per cent	68.4	68.2	71.7	73.8	75.1
18		Fig. 2	Theoretical reduction in nonextraction heat rate, per cent	12.82	12.82	12.82	12.82	12.82
19		17 × 18/100	Actual reduction in nonextraction heat rate, per cent	7.74	8.74	9.19	9.46	9.62
20		9 × 19/100	Actual reduction in nonextraction heat rate, Btu per kwhr	1099	1070	1080	1090	1110
21	HR	9 — 20	Heat rate with feedwater heating, Btu per kwhr	13,030	11,190	10,650	10,450	10,440
22		6 — 14	Heat added in boiler, Btu per lb	1199.7	1155.7	1127.4	1105.2	1084.9
23	F_T	21 × Load/22	Throttle flow with feedwater heating, lb per hr	27,150	48,480	70,880	94,580	120,000
24		1 × 1.25	Pressure of feedwater leaving boiler feed pump at 4/4 load, psia	—	—	—	750	—
25		Fig. 6 at 24 and 250 F	Isentropic work of liquid compression at 4/4 load, Btu per lb	—	—	—	2.3	—
26		Given	Boiler feed pump efficiency at 4/4 load, per cent	—	—	—	0.66	—
27		23 × 25/26 × 3413	Input to boiler feed pump at 4/4 load, kw	—	—	—	97	—
28		Fig. 7 at 23	Input to boiler feed pump / Input to boiler feed pump at 4/4 load, fraction	0.733	0.80	0.89	1.0	1.123
29		27 × 28	Input to boiler feed pump, kw	71	78	86	97	109
30		Use 0.7	Net effectiveness of boiler feed pump work, fraction	0.7	0.7	0.7	0.7	0.7
31		21 × 29 × 30/Load	Increase of heat rate due to boiler feed pump work, Btu per kwhr	259	122	86	71	64
32	HR	21 + 31	Heat rate corrected for boiler feed pump work, Btu per kwhr	13,289	11,312	10,736	10,521	10,504
33	F_T	32 × Load/22	Throttle flow with feedwater heating, lb per hr	27,700	48,900	71,400	95,200	120,700
34		Fig. 4 at 15	Total extraction as per cent of throttle flow	15.3	19.1	21.4	23.3	24.7
35		33 × 34/100	Total extraction, lb per hr	4248	9348	15,280	22,280	29,800
36	F_c	33 — 35	Flow to condenser, lb per hr	23,460	39,560	56,120	73,000	90,900
37		Fig. 3 at 14	t — h	31.5	30.5	29.6	28.7	27.7
38	t	14 + 37	Final temperature of feedwater, deg F	252.7	295.7	323.1	344.4	361.7

If boiler feed pump work is not considered, lines 24 to 31 inclusive may be omitted and lines 32 and 33 will be the same as 21 and 23 respectively. In this case, boiler feed pump input is included in the auxiliary losses of the power plant.



intended purpose. Since difference in heat rate is convertible to difference in fuel cost which may be capitalized, the cost of more expensive equipment can be evaluated.

As initial pressure is increased, boiler feed pump work has a much greater influence on heat rate. In the lower pressure range, enthalpy increase due to boiler feed pump work is relatively small and is neglected, and power requirements of the pump are included in the auxiliary losses. Parts 1 and 3, however, include steps for increasing the heat rate to correct for the net effect of boiler feed pump work. When these steps are used, pump power input is not included in auxiliary losses.

Fig. 3 has been plotted from data taken by permission from "The Thermodynamic Properties of Steam" by Keenan and Keyes, John Wiley and Sons, New York, 1936.

All of these calculations utilize data that have been in use for many years. Like the basic information, Parts 1 and 3 incorporate all of the feedwater heaters in the cycle as a unit and are not concerned with arrangement or type of individual heaters.

Part 2 is available for estimating performance of individual heaters. It assumes the heaters have equal heat rises and that condensate is pumped into the feedwater on the high side of the heater. Total cost of all heaters based on performance predicted in this manner should be a close approximation to the actual total cost.

In Part 1, final feedwater temperature at 4/4 load is assumed to be at 80 per cent of the optimum heat rise of the feedwater as shown on Fig. 1 at the peak of the curve for the number of heaters that are being used. This gives a reasonably economical arrangement for feedwater heating. Other final feedwater temperatures might be used, in which case Items 12 and 13 would be omitted and Items 14, 15, 16, and 17 would be worked out in reverse order by slightly varied methods.

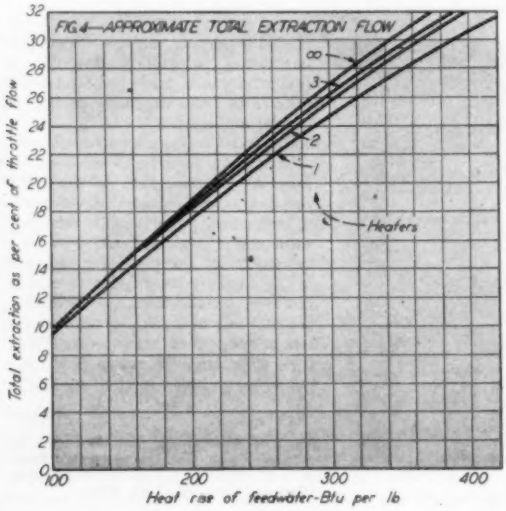
EXAMPLE OF PART 1 FOR A 10,000 KW, 60 CYCLE TURBINE-GENERATOR

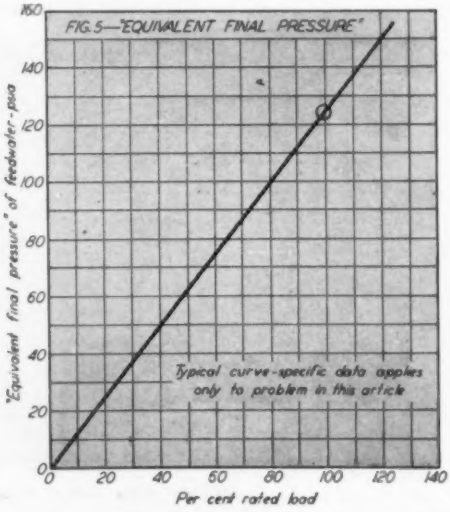
Line	Symbol	Source	Numerical value				
1	P_1	Given	400	600	600	850	850
2	T_1	Given	750	825	900	900	950
3	$P_{1'}$	Given	1.5	1.5	1.5	1.5	1.5
4		*See references	9.17	8.48	8.03	7.92	7.65
5	H_0	At 1 and 2	1388.9	1420.9	1461.9	1453.1	1481.2
6	h_c	At 3	59.7	59.7	59.7	59.7	59.7
7		5 − 6	1329.2	1361.2	1402.2	1393.4	1421.5
8		4 × 7	12,180	11,540	11,260	11,040	10,870
9		At 1	428	475	475	521	521
10		9 − 6	368.3	415.3	415.3	461.3	461.3
11		Select	4	4	4	4	4
12		Fig. 1 at 11	77	77	77	77	77
13		Use 0.8	0.8	0.8	0.8	0.8	0.8
14		12 × 13	61.6	61.6	61.6	61.6	61.6
15		10 × 14/100	227.0	256.0	256.0	284.0	284.0
16	h_f	6 + 15	286.7	315.7	315.7	343.7	343.7
17		Fig. 3 at 16	29.8	28.7	28.7	27.2	27.2
18	t_f	16 + 17	316.5	344.4	344.4	370.9	370.9
19		Fig. 1 at 14	73.8	73.8	73.8	73.8	73.8
20		Fig. 2	11.95	12.82	12.42	13.62	13.33
21		19 × 20/100	8.82	9.46	9.16	10.05	9.83
22		8 × 21/100	1070	1090	1030	1110	1070
23	HR	8 − 22	11,110	10,450	10,230	9930	9800
24		5 − 16	1102.2	1105.2	1146.2	1109.4	1137.5
25	F_T	23 × Load/24	100,800	94,500	89,200	89,500	86,200
26		1 × 1.25	500	750	750	1060	1060
27		Fig. 6 at 26 and 250 F	1.49	2.3	2.3	3.3	3.3
28		Given	0.46	0.46	0.46	0.46	0.46
29		25 × 27/28 × 3413	67	97	91	131	126
30		Use 0.7	0.7	0.7	0.7	0.7	0.7
31		23 × 29 × 30/Rating	52	71	65	91	87
32	HR	23 + 31	11,162	10,521	10,295	10,021	9887
33	F_T	32 × Load/24	101,300	95,200	89,800	90,300	86,900
34		Fig. 4 at 18	20.9	23.3	23.3	25.4	25.4
35		33 × 34/100	21,200	22,200	20,900	23,000	22,100
36	F_C	33 − 35	80,100	73,000	68,900	67,300	64,800

Fractional Load Heat Rates

Part 3 for calculating comparable heat rates at fractional loads uses an empirical relationship between final feedwater temperature and load. This empirical relationship resulted from a study of a number of sets of feedwater heating calculations covering the whole range of load. At each final enthalpy of the feedwater, the pressure for saturated liquid was read from the steam tables. For each series of calculations these pressures, called "Equivalent Final Pressure" of feedwater, were plotted against fractions of rated load. A straight-line was drawn from the origin and through the pressure at 4/4 load. Variation of the actual pressures from this straight line was relatively slight. In the absence of actual calculations, this empirical relationship is a convenient means for estimating final enthalpy of the feedwater at fractions of load (see Fig. 5) when final enthalpy for full load is known or assumed.

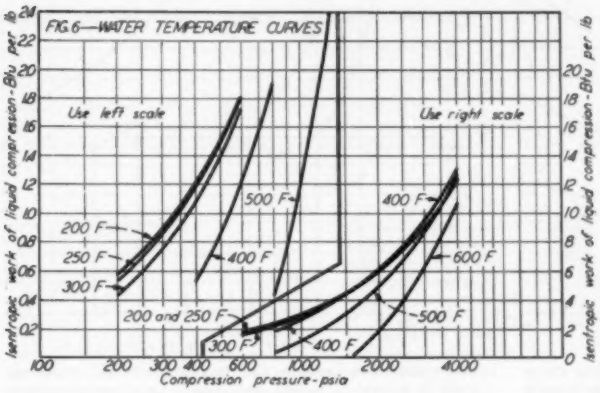
Steam rates*, the key to these calculations, may be: (a) read from Fig. 8 which lists approximate steam rates for condensing turbine-generator sets to 15,000 kw capacity, (b) obtained from the turbine manufacturer, (c) calculated from instructions included

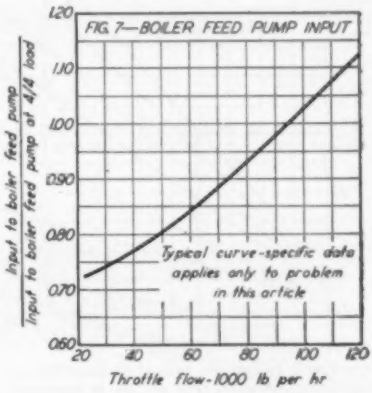


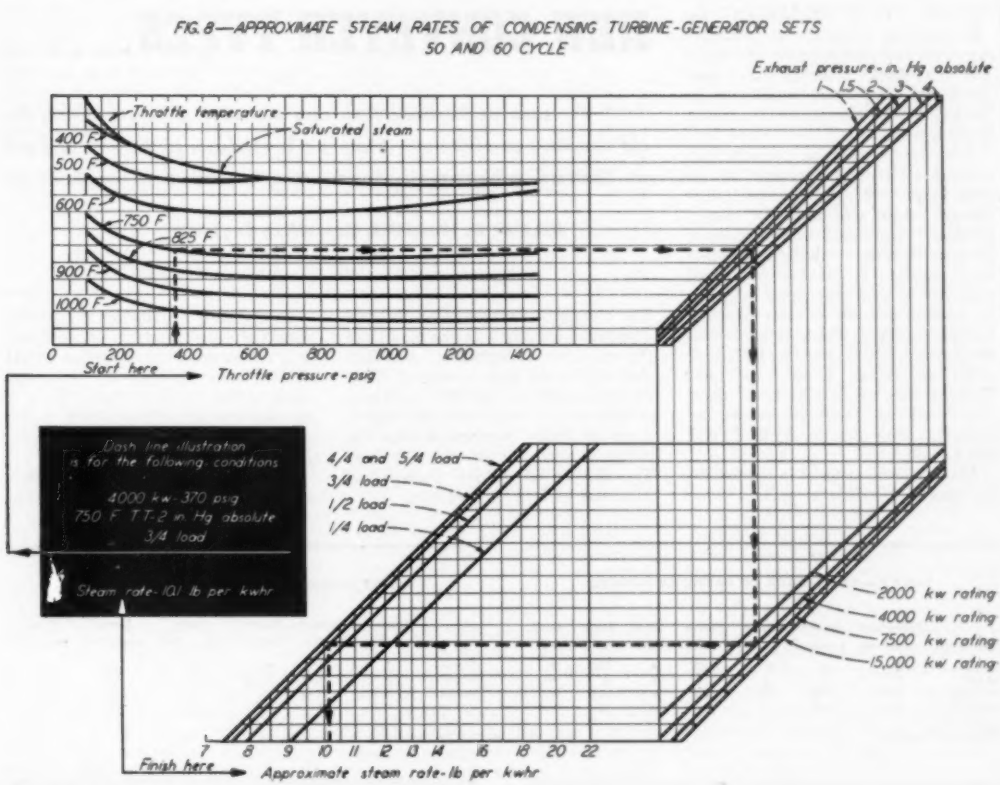


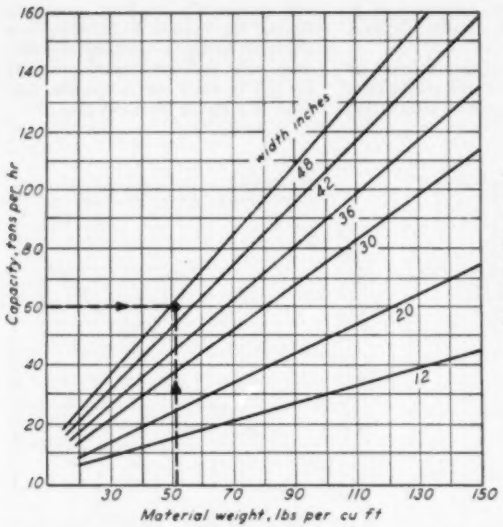
in the article *"Relative Engine Efficiencies Realizable from Large Modern Steam Turbine-Generator Units"* by G. B. Warren and P. H. Knowlton, ASME Transactions, 1941, or (d) determined from data on straight condensing steam rates contained in J. K. Salisbury's book, *"Steam Turbines and Their Cycles"*.

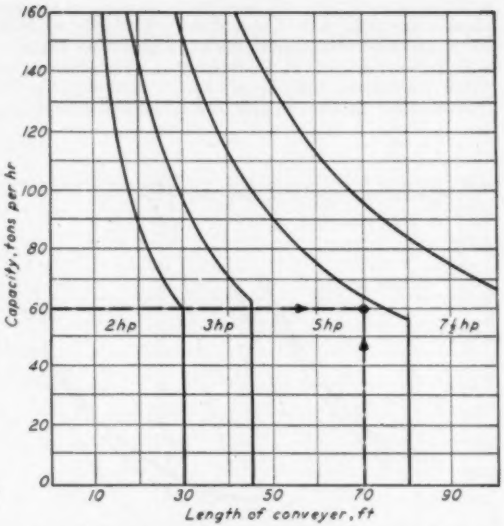
With the necessary data at hand, by substituting figures in the proper lines according to the procedure explanation and occasionally checking magnitude against the numerical example, any engineer having a speaking acquaintance with feedwater heating should be able to work out comparable heat rates in a reasonably short time.











These two charts are typical of manufacturers' data for a vibrating conveyor. One on left is employed to determine belt width when capacity and density are known. Chart on right is helpful in finding horsepower requirements direct

NEW CONVEYER TYPES.....

• • • such as fluidized flow and vibrating units are giving the old standbys competition. Here is a breakdown of the new and old to illustrate advantages, disadvantages, and best applications

WILBUR G. HUDSON, *Consulting Engineer*

TWO "OLD RELIABLES" for handling materials at moderate capacities and path lengths—the screw and the flight conveyer—are now faced with competitors, which may do the job as well, and sometimes can do it much better.

One development of particular interest is a rectangular trough with a false bottom of special woven fabric through which air—at a few ounces pressure maintained by a constant pressure-variable volume blower—filters upward to *fluidize* pulverized materials so they float along by gravity. Another development is a vibrating trough conveyer, which *bounces* material,even heavy fragments and lumps, along the trough at 30 to 50 fpm. Table 1 lists the suitability of these four machines (with exceptions, of course), rating them as A, B, C, and not suitable.

Movement of material in the fluidizing system is strictly a gravity flow. The trough or duct must be inclined downward, usually 4 deg or more, and the machine is limited to materials that will aerate, such as cement, lime, bentonite, soda ash, and fly ash. Where suitable it is a better machine than a screw or flight conveyer in that the power requirement is extremely low. The absence of moving parts eliminates risk of injury to workers.

In one early installation at a cement manufacturing plant, eight original mill circuit screw conveyers had a total of 200 motor hp. Each of the present units, which replaced them, has a 2 hp fan. The air volume is 3 to 5 cfm per sq ft of fabric and the slopes vary from 4 to 6.5 deg.

Vibrating conveyers give the material short forward, high-frequency im-

TABLE 1 — COMPARISON OF MATERIALS HANDLED

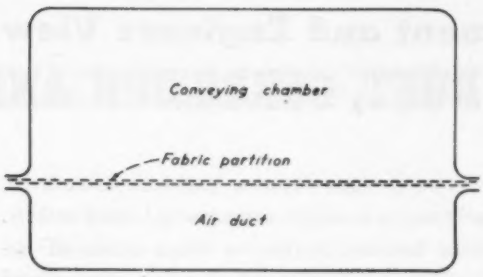
Conveyor	Pulverized abrasives	Heavy granules	Lumpy	Heavy castings	Slack coal	Lump coal	Sand wet
Screw	B	A	B	NG	A	NG	B
Flight	C	A	A	C	A	B	NG
Fluidize	A*	NG	NG	NG	NG	NG	NG
Vibrating	A	A	A	A	A	A	NG

*Those that aerate

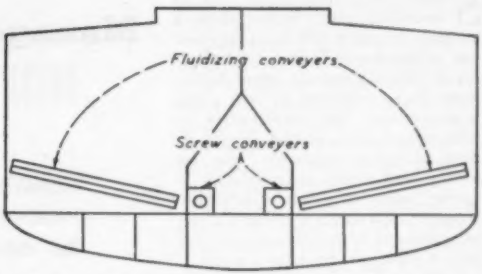
TABLE 2—COMPARISON OF CHARACTERISTICS

Conveyor	Upward incline	Downward incline	Curvilinear	Parts replacement	Larger capacities	Long centers**
Screw	B	A	NG	C	C	C
Flight	A	A	NG	B	A	A
Fluidize	NG	A	A	B	A	A
Vibrating	NG	A	NG	A	B	C

**With single unit



Cross section of a fluidized duct shows the air and material chambers. Material is fluidized by pressures in ounces



Air, at 12 to 20 oz pressure and supplied at the rate of 5 cfm per sq ft of partition, handles bulk cement readily

pulses along a trough mounted on rearward-slanted cantilever supports. The unit is driven by an eccentric shaft and connecting rod assembly at 400-500 strokes per min. In one type the supporting arms are connected to torsion bars embedded in rubber bushings, which serve as reactor springs, absorbing the energy of the trough movement at each end of the stroke. Full stroke is maintained regardless of surges or overloads.

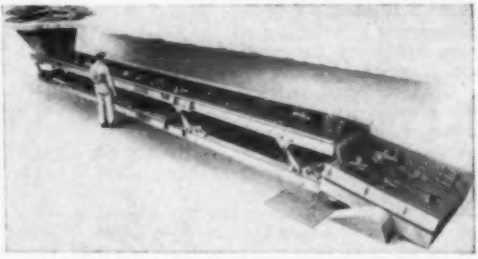
Screw or flight conveyers have the edge on these competitors in that they can handle materials along a path inclined upward at 30 deg or more. However, since the material is dragged along a trough—usually of sheet steel—the grinding action and friction with abrasive materials can be serious. When the material has a temperature sufficiently high to char the fabric diaphragm, the fluidizing system cannot function. The vibrating unit functions regardless of material temperature, and it may be equipped with a louvre pan or trough bottom and ventilated hood to cool the material while in transit.

Screw conveyers are standardized up to 24 in. diam with capacities up to 10,000 cfh. The length is limited by the torsional strength of the spindle. The horse power requirement is highest of the machines under discussion.

Flight conveyers are available for almost unlimited capacities and centers length. When the capacity reaches 100 tph, the system enters into competition with the belt conveyer, which has far wider possibilities.

Power determinations for the fluidizing method are not immediately available. However, it is only a small fraction as compared to the others since gravity does most of the work. Usually a layout permitting a slight downward slope is feasible. The machine then has an advantage over the others as a curvilinear path is permitted with a single unit, whereas the others require a tandem unit for each

Pan of this vibrating conveyor is given 400 to 500 short cycle impulses per minute. Material is bounced along at 30 to 50 fpm. The pan can be perforated, and unit can then serve as a shakeout



change of direction in a horizontal plane.

Vibrating conveyer capacity is a function of the trough width. Standard widths range from 12 to 48 in. The machine has one feature that may dictate its selection—availability for screening out material enroute, as for a foundry sand shake-out.

A direct comparison can be shown between the systems by assuming the problem of transferring slack coal, horizontally, 70 ft, at 60 tph. This material could be conveyed by a vibrating trough 48 in. in width and operated with a 5 hp motor. For the screw conveyer a 16 in. unit at 60 rpm and a 7½ hp motor are required. For the flight conveyer a 6 x 12 in. scraper-flight machine at 100 fpm with a 5 hp motor would be required. The fluidizing unit is not applicable.

Another comparison would be for materials having a high coefficient of friction on steel plate, such as cement, which has a 0.93 friction coefficient as compared with 0.59 for bituminous coal of 0.33 for anthracite. The capacity can be assumed to be 20 tph with a conveyed distance of 100 ft.

A 12 in. screw at 45 rpm would be necessary. This requires an 8½ hp motor. The torque capacity of the standard 12 in. screw with 2 in. pipe shaft is 6000 in.-lb. The conveyer in question has a torque of 10,000 in.-lb, so a 3 in. pipe shaft having a capacity of 16,400 in.-lb would be selected.

A 6 x 12 in. scraper flight conveyer at 50 fpm powered with 7 hp motor would meet the specific conditions. It costs substantially more than the screw conveyer. A 12 in. vibrator with a 7½ hp motor would meet requirements. A 10 in. fluidizing unit to handle this material would cost less than the others. Power requirement would depend on the slope, but should not be more than 3 hp.

This last analysis introduces or illustrates one advantage in floating the material as contrasted with dragging it along a trough. However, there is another advantage as finely pulverized abrasive material, in addition to cutting the trough, can work into the hanger bearings of a screw conveyer and into the chain joints of a flight conveyer.

Long life with low maintenance is far more important in the average industrial installation than power and initial cost. However, this discussion is not intended to suggest that the screw and flight conveyer are licked by these challengers. There are many installations, which have been doing the job assigned to them for 20 yr or more of active service with complete satisfaction. The discussion does indicate the possible alternatives in problems where the old line conveyers are handicapped by certain requirements or conditions.

Management and Engineer View

DUST, CORROSION AND

Conditions severe as those found in chemical plants in the Houston-Gulf Coast are seldom encountered in their entirety. But these case histories provide, in effect, results of accelerated life tests for individual situations encountered in lesser degree in many locations. Including both the non-technical problems of management and technical difficulties of the engineer, the viewpoints and solutions are valuable to all readers. In two parts, the second will appear soon

SMALL AND MEDIUM SIZED industrial plants often show a tendency to prefer low initial expense and minimum performance standards for distribution systems when making plans for construction of new plants in a new area. The practice often invites unwarranted criticism from technical electrical engineers who are usually well versed in economics as applied solely to power distribution. However, that factor is often a minor one compared to the more general subject of plant economies as a whole.

Success of a new plant in a new area, even if owned by a major industrial company, is not always guaranteed. It is sometimes highly desirable to reduce all initial construction costs as much as possible to enable plant management to see if general conditions will permit fair return on any capital investment in that area.

Upon competent technical advice, this practice may sometimes be condoned if management realizes that electrical operating costs will nearly always be increased and that reliability or power continuity decreases. A calculated risk by management may pay off on a short term basis where it cannot be economical for a long term. The decision must be made by management; it is the function of the consulting engineer to provide the necessary technical data and cost comparison.

Reasons for Minimum Systems

An electrical system deliberately planned under these conditions will almost inexorably fall under a broad category of inadequate or poorly designed systems by modern technical standards. Other factors may also tend to reduce electrical systems to this same broad class, even though minimum standards were not specifically intended in initial planning.

Many plants in Houston-Gulf Coast area have been built under booming construction conditions reflected from rapid industrial growth of the area. Material shortages have often existed and too frequently demanded substitutes to meet construction time schedules. An electrical system not as excellent as planned results. The ultimate extra costs and inconveniences are again deliberately absorbed by decision of management which cannot permit a portion of the capital investment to delay production representing a return on the total investment.

Furthermore, Gulf Coast climatic conditions impose special problems on electrical distribution. They are often unbelievable to engineers accustomed to entirely different conditions in other areas. Very favorable economic conditions as a whole exist in the Gulf Coast or its present industrial growth would not be possible.

It cannot be said, however, that generally favorable climatic conditions exist in this area for methods found generally suitable for electrical problems in older industrial areas. The worst conditions usually occur when chemical products or by-products which may escape to the atmosphere combine with generally bad and corrosive atmospheric conditions. Electrical equipment is attacked with a catalytic effect in ways quite unpredictable until actual experience is gained.

Electrical manufacturers are now keenly aware of this problem. In cooperation with technical staffs of the various industrial companies and consulting engineering firms, they are beginning to develop more suitable equipment and materials. At somewhat greater cost, they may be incorporated into an integrated and generally excellent electrical system. However, adequate maintenance of any electrical power system, no matter how excellent in design, remains a critical factor in economic operation.

Another factor is sometimes attributed to management itself but is in reality the joint responsibility and/or failure of the engineering staff or consultant. Management sometimes appears to deliberately blind itself to competent technical advice and to ignore technical decisions in favor of personal prejudices. But it often has not been presented with a technical analysis in lay terms understandable to non-technical personnel.

It is rather infrequent that top management is obtained from engineering ranks. Therefore, it is quite understandable that the engineer's job is to present technical advice in terms that management can translate into economics prior to making appropriations.

A poor system is full of hidden costs (both operating and maintenance) which may often be reflected by a longer amortization rate on lower initial cost. In addition, interruptions to plant power may seriously affect the amortization rate on the entire plant.

Importance of Planning

Even an electrical system good by modern standards cannot guarantee "no interruptions" to plant power. Significantly, however, less outage time for the plant as a whole occurs if circuit breaker coordination and isolation of circuits are properly planned. Consequently, only a portion of the plant suffers interruption of production. At the same time, proper isolation methods of faulted circuits may permit rapid repair with complete safety to maintenance personnel.

For the small plant, one advantage of the minimum standard electrical system (as judged by minimum permissible standards of the various codes and building ordinances) is that while new, it may give relatively trouble-free performance. This may give the small plant time to accumulate experience on production costs and profits. Although usually overlooked, this is the strategic period to reconsider the electrical system economics and its relation to over-all plant operation and efficiency.

More often consideration is delayed until deterioration and corrosion cause annoyance to plant production and reduction of plant profits. Moreover, when the plant begins to expand and require more power than the old system can deliver, additional distribution and plant production problems will exist.

Economic factors may not be at all similar to those existing when the

ELECTRICAL DISTRIBUTION

- Value of a minimum standard system for experience gained
- Distribution system economics versus capital investment
- Effect of dust and corrosion on minimum equipment
- Replacing war time and post war substitutes
- Improved reliability of service on a limited budget
- Conversion and expansion while maintaining service

HAROLD E. McCONNELL, *Consulting Engineer*

plant was first built. Then it becomes imperative that a re-examination of the electrical system be made. Making the expanded electrical system self-amortizing through its indirect relationship to plant costs and profits becomes of considerably greater importance than at any previous time.

Electrical power is the life blood of a plant, and more and more plant executives are coming to an appreciation of this fact. In the average plant, it does all the work. A plant which demands 3000 kw of electrical power means little to the layman. But work done in that plant is equal to all that could be done by 4000 strong horses with no time out for the feed bag or rest period.

However, complicated drive systems and speeded-up operations require a type of mechanical work not analogous with the power physically available from the standard rate of work unit, the horse-power.

The electrical system is capable of all this, and more, at the touch of a button. Such tremendous capacity with its practically instantaneous response, demands adequate supervisory and control methods.

If plant power is to be doubled, control methods capable of restraining 3000 kw will not necessarily handle 6000. Cost of control is increased but useful work which may be done is doubled. The entire cost of a good electrical system is often less than for the conveyer system needed to carry the finished product out of the plant.

Case Histories

As an example of trends for modernization in electrical systems, recent expansion plans of two separate plants located in the Houston-Gulf Coast area will be described. (The second case history will appear in an early issue).

The plants are located miles apart and do not have the same operating or production problems. Except for falling into the broad classification of "chemical plant", their processes and products are entirely different. Both are branch plants under management by large companies, and both were constructed within the last ten years.

Upon initial construction, each plant had at least some elements of the minimum standard electrical systems previously discussed, for completely separate but sufficient reasons. Each plant needed electrical power above the capacity of the then existing system, and each wished maximum reliability within the available appropriations for electrical system improvements.

MATHIESON CHEMICAL PLANT

The first project is that of the Mathieson Chemical Corporation. Within comparatively recent years, it purchased the fertilizer plant located on the ship channel near Pasadena, Texas, and originally built under war-time conditions and scarcities.

There was an extraordinary mixture of expensive and well designed electrical equipment, coupled with equipment and construction methods which could only be described as make-shift. This could be interpreted only as the direct result of scarcities and the necessity for immediate operation.

The most unusual condition encountered caused a type of corrosion as severe and troublesome as any ever observed by the writer. Layers of finely ground product dust were clinging to all equipment in the plant.

The dust escaped from various points in the process, and condensation from the humid gulf coast climate provides sufficient dampness to allow it to cling to every exposed surface. In contact with moisture, it produced two very active acids having serious effects on many construction materials.

Additional layers of dust made acid escape impossible except when deliberately cleaned by scraping or hosing. Outdoor and indoor equipment alike was attacked with disastrous effects. Exceptionally heavy rains seemed to have a somewhat temporary beneficial effect for outdoor equipment, as they tended to wash off the dust deposits, but ordinary light rains merely aggravated the condition.

The corporation, which maintains an engineering staff at Pasadena in addition to occasionally calling in outside consultants, adopted a very progressive and far-sighted policy from the beginning of their ownership. They had made tremendous efforts in the way of maintenance and rehabilitation of existing plant equipment. Even so, there were many difficulties probably not experienced to the same degree by the original management due to the tendency, previously discussed, of any electrical system to operate better when new. Their solutions were as follows:

About This Article

The average reader is busy. He also has the technical ability, handbooks and other necessary means at his disposal for solving specific problems as necessary. Therefore, INDUSTRY AND POWER normally confines electrical editorial to trends, fundamentals, experience of other engineers, expert opinions and unusual problems and solutions. The aim is to cover the critical planning stage of the widely varied Engineered Plant Services as adequately as possible with concise, easily read articles. Half-hearted attempts to treat the encyclopedic field of design and maintenance details which make tedious reading are avoided.

Occasionally, however, an article worth extra reading time is received. In this case, the author, as an advisory liason agent, has interlaced the managerial and engineering staff problems with practical experiences. Any attempt to break the article into smaller parts would spoil the underlying conceptions. This installment and the second (to appear in an early issue) each coordinate viewpoints in a manner worth 20 to 30 minutes reading time for both management and engineers.

Original Distribution System

The electrical system consisted of a main power substation, located well within the plant property, for receiving power at 69 kv. The utility spur line ran from the main right of way, a distance of about half a mile. It had back-up protection by open type 69 kv fuse cutouts at the take-off point, and disconnects for manual no-load switching to either of the two main 69 kv lines. The two main lines are well maintained, but act as parallel primary feeders carrying power to a large number of heavy industrial plants in that area.

Occasionally, severe faults within the Mathieson property could not be coordinated and would knock out the main breaker at the utility company substation. Other plants in that area also occasionally caused power interruption on that line, which increased the number of outages.

The utility spur line was terminated at the substation by strain insulators to a wooden structure. The substation included 69 kv lightning arresters and hook operated disconnects and a large pneumatically operated 69 kv oil circuit breaker with open bushings. The 3 phase, 3750 kva, oil immersed, surface cooled (OISC) transformer was arranged for 67 kv delta to 2400 v delta, with forced air cooling fans for increased capacity and with both high and low voltage cover bushings.

Main secondary switchgear consisted of metal cubicle enclosed, manual load break switch and fuse combinations for various outgoing feeder lines. The gear was located indoors in a small switch house adjacent to the transformer, and connected to the low voltage bushings by heavy copper bus bar of ample thermal capacity, sleeved through the switch house wall.

All major distribution within the plant was at 2300 v, 3 phase, with open pole line construction. Bare conductors were mounted on pin insulators and cross arms. These overhead lines were connected to the switchgear by underground sections of conduit enclosed, 5 kv lead cable, the pole risers terminating in conduit coupled potheads. Pellet type lightning arresters were placed at take-off points on the pole lines.

All 2300 v lines were radial and served one or more 440 v substations and 2300 v motor load centers. In addition, several small single phase 2400/120/240 v lighting transformers were tapped to these lines, usually in such a manner that a good 3 phase balanced load was maintained on the radial feeder.

The 440 v substations consisted of OISC transformers on concrete slabs outdoors, and were initially located quite close to the major load concentrations. The larger substations (450-600 kva) consisted of three single phase transformers, delta connected in typical outdoor fashion to a 2300 v copper bus bar above the transformer, with 5 kv open type fuse disconnects between radial line and bus.

Many three phase, 2300 v motors, 100 hp and above, were served by the radial lines, usually by conduit enclosed, lead cable tapped in at a convenient pole, with separate sets of open fuse disconnects for each line take-off. These feeders usually terminated in a bank of indoor metal enclosed reduced voltage starters of excellent design and manufacture. Each starter contained adequate overload and short-circuit protection for individual motors.

440 V Utilization Circuits

To outward appearances, the 2300 v system conformed to reasonable rules of good practice. Design was similar to that in several other plants in this area.

The 440 v system was not as good. A marked tendency existed to tap several long, heavily loaded main branch lines directly to the transformer terminals with no main secondary or other protection. These lines usually terminated in starter rooms placed indoors, or at starter racks on loading platforms in semi-outdoor locations. The Mathieson practice was to enclose all 440 v starters in heavy cast-iron, dust-tight enclosures. But by far the greater number of starters on the original installation were in NEMA 1 enclosures, badly deteriorated.

Recent Expansions

The first expansion was a new acid plant built by Mathieson. This was served from a spare switch and fuse combination in the switch house. Overhead aerial cable feeds an outdoor unitized 440 v substation, complete with main secondary breaker and necessary branch circuit breakers. It has given very satisfactory performance up to the present.

High voltage terminals of this substation are in enclosed terminal chambers. The throat connected, secondary switchgear is completely weatherproof and fairly dust-tight, and is equipped with strip heaters to keep out moisture and condensation. The acid plant is outside the dust area, and the unit substation is not located too close to acid polluted areas.

The second expansion consisted primarily of increasing capacity of existing processes and mills. The various processes have many motor applications, from small pumps and conveyers to large 500 hp grinders and other heavy drive machines. The power transformer was no longer large enough, making another necessary.

Troubles From Deterioration

In addition, the existing power system had been operating unsatisfactorily for some time. Pin type insulators consistently flashed over from dust accumulations, setting cross arms on fire and causing prolonged outages. Open type disconnects corroded and became inoperative. Potheads, of a type never known to seriously corrode in so short a time, were sometimes eaten through the cast bodies.

Porcelain on transformer and pothead bushings, strain and pin insulators, and on the oil circuit breaker soon lost their glaze and insulating properties, in addition to flashovers caused by dust accumulations. At one time, the 69 kv oil circuit breaker was inoperative because of damaged bushings, and remained so for a considerable time because such items seldom fail and are not usually stocked by the manufacturer.

Copper stranding of overhead lines was severely corroded. Several lines were found hanging by only a few strands. 440 v substation transformers tended to overheat because of dust accumulations and suffered considerable outage time because of corrosion.

The maintenance staff was overworked by all these problems and was further hampered by the fact that most of the processes demanded continuity of service with little opportunity for adequate maintenance shutdowns.

Planning for the Future

Under such conditions, management wisely made a good sized electrical appropriation. Work was started on detailed plans and construction drawings for a system which would be suitable under the appropriation.

Major considerations for the new system were:

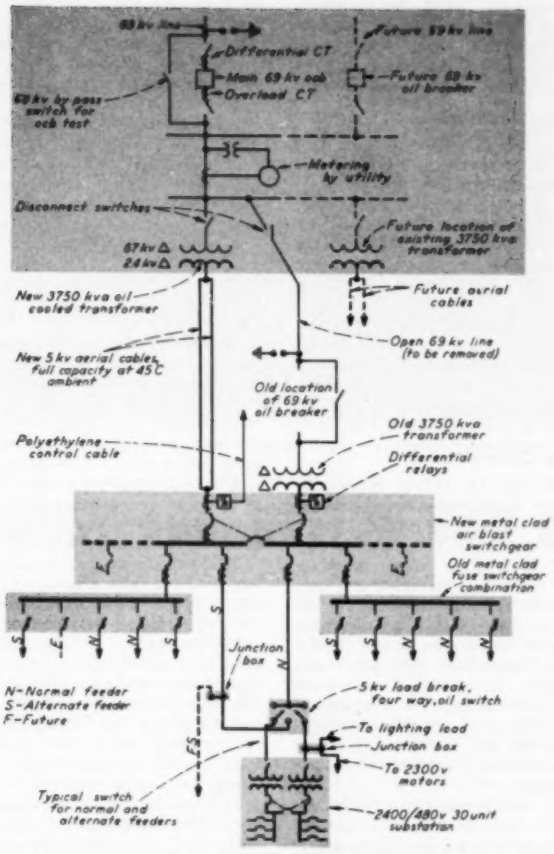
1. To provide increased power capacity to the Pasadena Fertilizer and Acid Plants.

2. To reduce to a minimum the number of serious outages by a combination of operating flexibility and of new equipment designed to withstand the severe conditions.

3. To provide a flexible system capable of future expansion with ease and best possible economy.

Approach to the extremely severe corrosion problems was from two directions: (a) to either protectively enclose live parts or to move equipment away from the most corrosive areas, and (b) where this was not possible or economical, to provide equipment capable of withstanding corrosive action for a considerable period.

It was decided to move the 69 kv


69 kv line
Future 69 kv line
Differential CT
Main 69 kv oil
Overload CT
Future 69 kv oil breaker
69 kv by pass switch for oil test
Metering by utility
Disconnect switches
Future location of existing 3750 kva transformer
67 kv Δ
24 kv Δ
New 3750 kva oil cooled transformer
Future aerial cables
Open 69 kv line (to be removed)
New 5 kv aerial cables, full capacity at 45 C ambient
Old location of 69 kv oil breaker
Old 3750 kva transformer
Polyethylene control cable
Differential relays
New metal clad air blast switchgear
Old metal clad fuse switchgear combination
Junction box
N-Normal feeder
S-Alternate feeder
F-Future
5 kv load break, four way, oil switch
To lighting load
Junction box
To 2300 v motors
Typical switch for normal and alternate feeders
2400/480 v 30 unit substation

In view of material scarcities, the original distribution system was adequate when new. It also provided experience in operation for post war production in the converted plant. Now, corroded equipment is replaced with better types, aerial cable helps limited budgets, and the secondary selective systems, above, add capacity and reliability even during the electrical system reconversion

power substation away from the dust area, some 700 ft from the old location, at the top of a small knoll in a corner of the plant property nearest the utility company line. The plant was to be kept operating from the old location while the new station was being installed.

A new steel substation structure and a new 3750 kva, 3 phase transformer were located at this point. Main 69 kv backup protection was obtained by moving the existing oil circuit breaker to the new location.

At the proper time, the utility company would terminate a parallel spur feeder from its alternate main line. In case of main line failure, a new oil circuit breaker to be installed later, suitably interlocked, will permit switching to the alternate feeder by plant personnel. This will avoid delays until utility line crews can perform manual switching. Their primary problem is to restore service to the faulted line for the benefit of all users.

The new transformer secondary studs are completely enclosed, and have stuffing box connections for two three conductor cables. The latter are supported aerially by messengers over the distance to the old switch house. Since the aerial cables run to the dust area they will be subject to its corrosive action. One of several good cables deemed to have protective jackets and insulation resistant to the acids was selected and equipped with stainless steel messenger and binder tape.

An X-braced, H-structure was designed, adequately guyed, to withstand 125 mph wind forces with the duplicate set of power cables to be added later. In the meantime, the existing overhead 69 kv line was shifted to a position feeding from horn-gap disconnect switches on the new substation, off the metered bus. Horn-gap disconnects are also used between this bus and the high voltage bushings of the new transformer. The one line diagram shows essential features of the system.

Fault Protection

This installation offers improved chances of completely trouble-free operation for the new transformer, but in no way changes conditions for the old transformer until it can be moved to the new location. For complete protection of either, a system of differential relaying was incorporated, with primary bushing current transformers on both transformers.

The old switch house was enlarged and a new set of modern metal clad, air blast circuit breakers installed. Secondary main breakers sized for full load of each transformer at 2300 v feed two separate 2300 v, three phase buses within the switchgear enclosure. The buses are connected by a tie breaker, key interlocked to the main breakers. Additional current transformers to complete the differential relaying were added to each secondary main. The relays themselves were located in the metal clad switchgear.

The existing switch and fuse combinations had proven reasonably satisfactory and have a very high interrupting capacity. Fortunately, this gear was conveniently arranged in two sections, back to back, and bused together at one end. The bus was removed and each section fed from a breaker on opposite sides of the new main bus, putting part of the original load on the new transformer and part on the old.

The tie breaker will insure that, in event of failure from either (but not both) main power transformers, 3750 kva will be continuously available to any radial line in the plant. This will permit maintenance of vital electrical services and still allow some margin to continue plant operation at reduced capacity.

The differential relays will, of course, remove all plant power by tripping the main 69 kv oil circuit breaker for a fault in transformer or cables to the switchgear. But it also signals such action, enabling quick manual removal of the faulted transformer and restoration of power to the remaining transformer in a matter of minutes.

The differential relaying, and other controls centralized at the new switchgear required multi-conductor control cables from the switch house to the new substation. Polyethylene insula-

tion and jacket were selected. Polyethylene is very resistant to chemicals of any kind, with unexcelled electrical insulation properties. Its application on an overhead messenger cable is relatively new, and its physical properties are not known with certainty, but high hopes are held for its success.

Polyethylene would have been ideal for the power cables for resistance to moisture and chemical corrosion. However, with a flash melting point close to present high copper temperature operating points, it was deemed not suitable for the vital power cable links.

Feeder Redesign

As many existing overhead open conductor lines as possible, under the available appropriations, were abandoned in favor of aerial cables with stainless steel binder and messenger for all important lines. They are similar in construction to the main 2300 v power cables. Individual loads on these feeders were re-grouped until it was possible to standardize on two sizes, one identical to the main power cables, the other somewhat smaller.

Well grounded messengers and lower clearances for the aerial cables make them virtually free of outages caused by lightning. Appearance of the plant will be considerably improved. Dust cannot touch live parts to cause flashover. The synthetic jacket is highly resistant to the expected chemical action, but some cable deterioration and failure may be expected over a long period.

With highly unsatisfactory experience with simple radial feeders, management desired a more reliable system of quickly restoring power to vital areas. The most economical method proved to be individual normal radial feeders to each major load area, augmented by alternate cables serving one or more normal feeders. Load break, oil immersed selector switches provide quick switching at the substations.

Each aerial cable feeder has adequate capacity for any one area, with ample spare capacity for additional emergency loads.

It was desired to keep alternate feeders energized at all times. Therefore, the cables are kept warm by designing switching so that small loads may be taken from the spare cable as normal procedure, providing a temperature a few degrees above ambient at all times. The procedure is highly desirable in this climate for any type of electrical equipment, especially motor and coil windings, and for cables.

The switching system is extremely flexible, but requires judgment in operating procedure. It would be possible to damage alternate feeders if careless switching placed the maximum demand load for both its normal feeders on it over a considerable period. However, capacity is adequate for brief overloads with ample switching time.

Interim Measures

As a transition step, some existing overhead lines were retained and used as the alternate feeder pending additional appropriations for more aerial cable. The switching arrangement allows complete de-energization of the open lines at any time maintenance work is necessary, with no interruption of power.

In one instance, an open overhead line could be re-routed through an area relatively free from dust at very low cost. However, long range planning and economics seem to call for eventual abandonment of all open lines.

For a Critical Load

Very large 440 v load increases in one area called for increased capacity beyond that of any existing 440 v transformer banks. This occurred at a critical point in the process which requires exceptional reliability and continuity of electrical service. Past experience demonstrated an abnormal number of transformer failures. Therefore, a double-ended 2400/440 v unit substation was purchased, with three phase transformers, 440 v secondary main breakers of adequate interrupting capacity and branch feeder breakers interconnected by a key interlocked tie breaker.

Each transformer can now handle the demand load of the present expansion. Combined capacity is slightly greater than any conceivable increase in load within the next few years.

Each transformer has an enclosed primary terminal chamber with oil fuse cutouts for protection. The 440 v secondary selective system here is similar to the 2300 v circuits in the main switch house. Even with failure of one transformer, all 440 v feeders may be energized simultaneously, with the necessity of reducing load on some feeders only if future expansion goes above present estimated demand.

For protection against dust, this substation is placed indoors with forced air ventilation and filtered louvres on the outside air intake.

For Other Locations

At another 440 v substation, a new and larger three phase transformer was installed in an outdoor location only partially sheltered from dust. Primary and secondary terminal chambers were used instead of the familiar cover or pocket bushings. Open fuse cutouts had proven unsatisfactory due to flashovers and corrosion failures. Completely enclosed, oil fuse cutouts were used as transformer primary disconnects and protection, as well as for the 2300 v motor feeder circuits connected at this substation.

Still another 440 v substation is in a location very vulnerable to dust accumulations and corrosion. Re-use of the old transformers freed by purchase of the new double ended unit was desired, particularly as the nature of service required in this plant may change in the future.

Open 2300 v buses and insulators were eliminated and high grade, 5 kv insulated and jacketed cable was installed in conduit above the bushings, with but short vertical exposure. Lugs at the bushings were heavily taped and coated with insulating varnish. Although three single phase transformers were used, no 5 kv splices were made above them. Each transformer had its lead extending a short distance to rack mounted, enclosed oil fuse cutouts, where it was double lugged and carefully taped as for a splice.

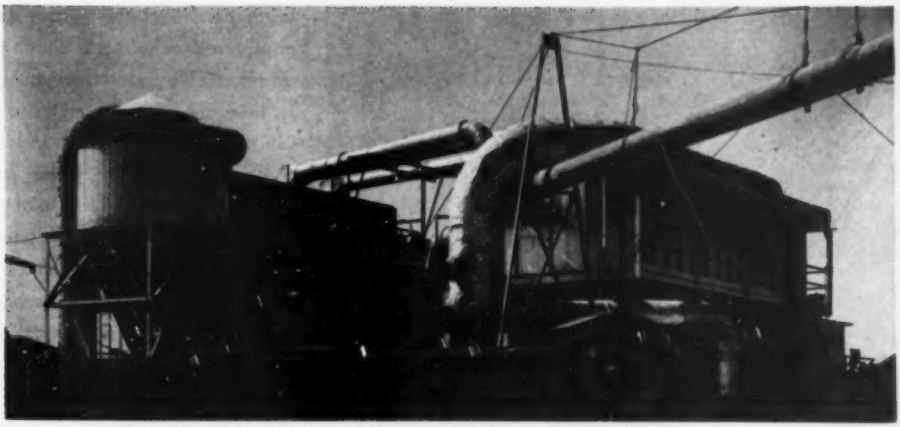
2300 v motor service from this point was provided from another set of enclosed oil fuse cutouts. A light shed was built around the substation for protection against falling dust deposits and acid drippings, and a large dash of hope and faith was added that this might prove to be a very great improvement over the former design.

For open lines scheduled to remain in service for an indefinite period, fog type pin and strain insulators are gradually being substituted for the standard types. The much higher leakage distances will allow more time between necessary repairs and reduce the hazard of heavy flashover faults.

Management and Engineering

This discussion reveals only essential changes to the distribution system revisions. Many problems will exist until all plans are realized. Even then, the management is too experienced to believe that all electrical problems will then be automatically solved.

They have strikingly demonstrated that management is not always unaware of electrical problems and they realize that much higher equipment costs may frequently be amortized out of savings to plant profits by reducing interruption time, rather than judging exclusively by costs shown as chargeable to the electrical department only. Those costs ordinarily considered under Kelvin's law are initial cost of equipment against dissipation losses and purely electrical operating and maintenance costs. Even then, too little attention is sometimes paid to the operating and maintenance costs as related to initial investment.



These collectors, mounted on the roof, remove more than 20 ton of dust every 24 hr

DUST COLLECTION CAN BE PROFITABLE

THE KELLOGG CO., Battle Creek, Mich., every year uses more than nine million bu of corn, one million bu of wheat, 60 million lb of bran, 50 million lb of rice, and 30 million lb of sugar. Processing these and other ingredients, from arrival until ready for packaging as a finished product, results in tremendous quantities of dust, which is explosive and combustible.

Installing a simple exhaust system to control inplant dust was impractical. Furthermore, such a system could create a major housekeeping job for the building and grounds crew along with contaminating the surrounding residential area. Cyclone collectors were used with only 95 per cent of the particles caught, but the firm wanted 100 per cent collection.

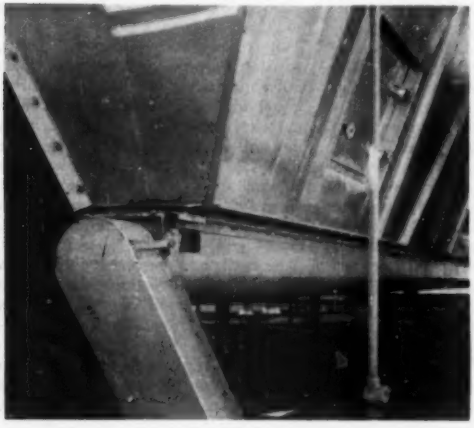
Kellogg engineers solved the problem by equipping every dust producing machine with hoods, which were tied into an exhaust system leading to roof-top centrifugal and cloth screen collectors. In the corn mill production lines, hoods and pipes have been built into driers; coolers, sifters, and aspirators before entering the final flaking process. Other hoods were installed where corn particles are sifted and separated, where roller mills grind up the germ stock and small corn particles, and where the malt and various flavorings are added. All of these operations produce dust, which is exhausted to two 4-section continuous automatic cloth screen collectors of the suction type located on the roof.

In the Gro-Pup (dog food) department, dust sources are numerous and include: (1) raw materials blending, (2) the conveyer system beneath the feeders, (3) the station where salt, calcium, and other concentrates are added, and (4) around the sifters, mixers, hammer mills, and grinders. Some of these particles are larger than those from the corn-mill line, so centrifugal collectors share the load with the cloth screen units.

Roof-top collectors are designed to collect dust on a cloth screen and, at pre-set intervals, to automatically remove the dust into hoppers. In turn the hoppers are provided with continuously operating screw conveyers so that collected material is dropped into storage bins.

Estimates have been made by Kellogg engineers that indicate the cloth screen units are collecting an average of 35 ton of dust per hour. As this dust is valued at $40.00 per ton, the result is a saving of $1400.00 per day in salvage profit. Of this, 20 ton per day comes from the Corn Mill and 15 ton per day from the Gro-Pup department. These collectors not only salvage dust, but separate particles from the air stream that formerly separated in the cyclone dust collectors.

The 40-acre Battle Creek plant is a maze of hood and piping systems exhausting to the collectors so efficiently that Kellogg's 3200 employees work in complete dust free comfort.



Dust from roof collectors falls into these bins, and is conveyed to storage bins by means of these screw conveyers

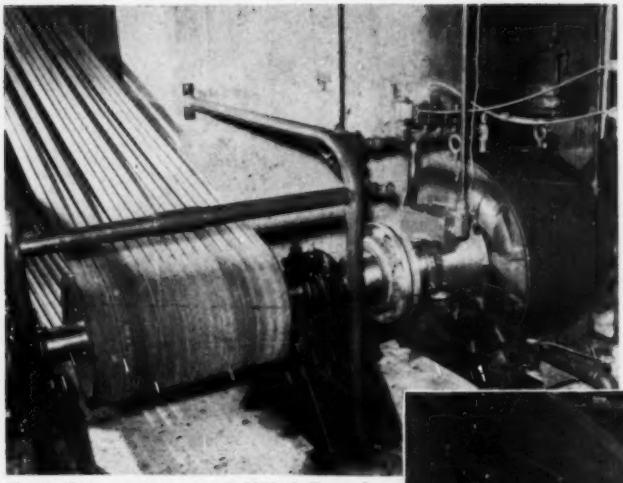


Fig. 1—This coupling, rated 2100 ft-lb peak torque, controls speed of a Fourdrinier machine between 200 and 600 fpm with plus or minus one per cent regulation at the Fletcher Paper Company. Motor is 200 hp, 1200 rpm

Fig. 2—At a cement mill, a 5 hp motor with coupling drives a slurry feeder, following the speed of the 200 hp, coupling controlled kiln drive. Couplings range from 1 to 18,000 hp

Eddy current couplings are usually considered either as a clutch or as an adjustable speed device. Actually, they are both although the latter use is the least understood. Here is a basic description of the equipment and its capabilities, along with answers to some of the pertinent questions often asked when the economic and operational aspects of an application are being considered

When to Use Eddy Current Couplings for SPEED CONTROL AND CLUTCHING

E. H. FREDRICK
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Dynamatic Corporation

EDDY CURRENT DEVICES are relatively new in general application in the field of mechanical power transmission although operating fundamentals have long been known. However, simple construction and control, and ability to function both as a clutch and as an adjustable speed device have made them increasingly popular in recent years.

The indiscriminate use of the words *magnetic, coupling* and *clutch* has led to some confusion in industry when used in connection with eddy current couplings. For example, the term *"magnetic clutch"* has been in common use for many years for an electrically operated friction clutch intended primarily for engaging or disengaging a load. In operation, it accelerates the load to full speed, and then runs in locked position. Also there are magnetic particle clutches with similar characteristics (although some very small sizes have been developed for adjustable speed applications).

The eddy current coupling will not positively lock the load to the driving shaft, it must always slip to a certain extent in order to develop appreciable torque. Unless this slight amount of slippage can be tolerated, the eddy current coupling cannot be used as a clutch in the common sense.

The term *coupling,* in common usage, refers to a mechanical connection for two shafts, usually by flexible means. In other words, any flexible coupling will allow relative misalignment or axial motion between the shafts. While no manufacturer recommends faulty alignment of the two shafts, it is a fact that a minor amount of parallel or angular misalignment can be taken care of by a normal flexible coupling.

The *eddy current coupling* is not intended to serve as a flexible coupling; it merely connects the two shafts, which should be in as perfect alignment as possible, and allows operation at differing speeds. Use of the term *eddy current* indicates torque is transmitted through the unit by reaction between the main and the eddy current fields, Fig. 3, and therefore implies that slippage must exist in order for the device to transmit torque.

It is possible, within certain limits, to control speed by a friction clutch but almost never recommended, particularly for high power. In addition to excessive wear, slippage of a friction device is relatively uncontrollable. The coefficient of friction varies with the amount of slip, the temperature of the faces, conditions of lubrication and other factors and is therefore, a relatively erratic function.

Since the eddy current coupling does not depend on friction in any form and since strength of eddy currents developed is easily controlled by changing excitation, degree of speed regulation can be very closely held at any slip point between full operating speed and near zero speed on the output member.

Simple Clutch Operation

There are many applications in which the eddy current unit will be justified for clutch operation alone. In cases where inertia loading on the output end is high relative to the rating of the motor, and operation only at full speed is required, the coupling is very often used with a fixed excitation supply. It permits starting a motor or engine at no load and, with the prime mover operating at normal speeds, accelerating the connected load which will subsequently run at a given top speed. This means that no excitation control except an "ON-OFF" switch is required.

However, amount of excitation in the coupling controls the rate of acceleration, and with little more equipment, the rate can be very closely adjusted to accelerate the load in a straight line or along an exponential curve. Since independent of friction, acceleration is smooth and shock free. Typical examples of controlled clutching are the industrial fork-lift truck drive, and couplings as applied on power shovels, derrick boats and railway type cranes, as well as many industrial applications requiring controlled acceleration.

As an Adjustable Speed Drive

The field of adjustable speed drives is probably as complex as any in the electrical industry. In almost every application, a great number of apparently unrelated factors affect selection of proper equipment. First cost is always a consideration. Maintenance expense usually is considered, but at times, it may not be too important. Input-output efficiency is also extremely important at times, but in other cases may have no influence whatever on the decision. Accuracy and ease of control vary considerably in importance depending on conditions.

It is very difficult to generalize as to when an eddy current coupling should be selected on the basis of characteristics and economics. It is, however, particularly in the water cooler type, a constant torque device with a characteristic similar to that of a wound rotor motor. On the other hand, control is easy and simple so that performance far and beyond that available from the wound rotor motor is relatively inexpensive and practical.

It should be noted, however, that the eddy current coupling is not a torque converter, but rather a simple torque transmitter. Because of that fact, torque cannot be multiplied by it. Furthermore, output speed of the coupling cannot be higher than the input speed.

In input-output efficiency, eddy cur-

How eddy currents transmit torque

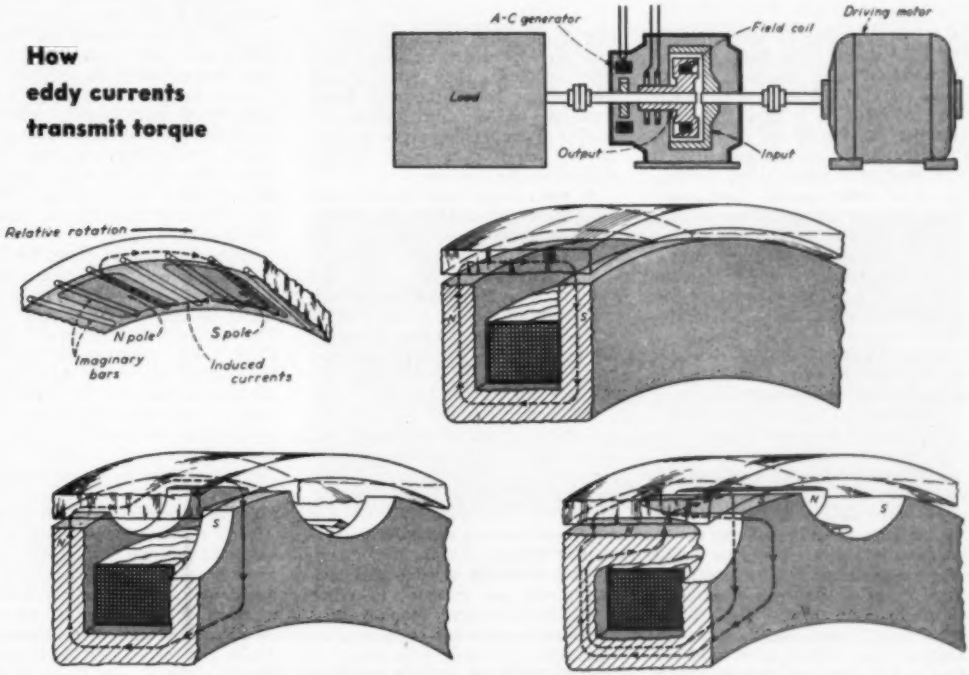


Fig. 3—Motor drives outer ring of coupling, upper right, which transmits torque to field structure mounted on driven shaft. Other sketches show how eddy currents are induced. Imaginary elements taken across ring, left center, perpendicular to relative motion, act like squirrel cage winding, short circuited by ring material itself. If ring rotates relatively to a salient pole field like that of a synchronous motor, currents are induced and their fields react with main field to produce torque, just as in a motor.

An annular magnet, similar to lifting magnet but designed so armature is a ring, right center, also produces flux in ring. But with even spacing shown, flux is distributed equally around gap and can produce no emf difference to circulate current. However, with staggered notches in field core, flux is concentrated, producing effect of alternate, but widely separated, poles. Eddy currents are induced as with salient pole machine, but high resistance path produces sloping curve similar to that for "gear tooth" rotor, Fig. 4.

If core teeth in sketch at left are extended across coil as at right, field distribution in air gap approaches that of salient poles, modified as desired for curve shape, Fig. 4, by designing proper tooth form.

Water-cooled coupling coils are hermetically sealed in a copper can for protection.

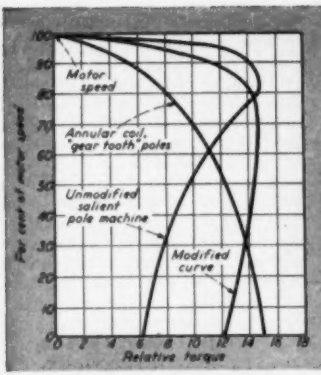


Fig. 4—Torque curves for salient pole machines are like those of a squirrel cage induction motor. However, annular fields may have poles designed to produce curves with more starting torque and better load characteristics

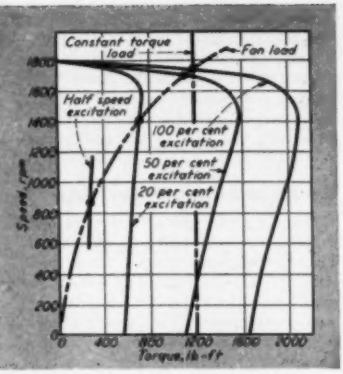


Fig. 5—Using a modified curve, this graph shows how output speed changes with excitation. To hold speed constant as load changes (causing shift in load curve) field control changes excitation for new coupling curve needed

rent couplings compare almost directly with the wound rotor motor over the entire speed range. Slip losses in both units are identical, since in both, torque is developed at input speed (or rotating field speed for the motor). The same torque is transmitted through the coupling or motor, as the case may be, at all lower speeds. Since power is a function of speed and torque, obviously power coming from either unit is proportional to output speed.

In other words, at 50 per cent output speed, output power would be approximately 50 per cent of the input. This condition does not necessarily exist with a torque converter in which input power decreases with speed (if output torque is constant). But it is normal with a d-c generator and motor combination, where true torque conversion comes from manipulation of the voltage and current being supplied to the d-c motor.

However, in most adjustable speed applications, operation of the driven machine normally takes place somewhere near its top speed where efficiency of the eddy current coupling is relatively high. In the water-cooled units on fair sized machines, over-all efficiency runs as high as 95 to 97 per cent at full speed and torque. Losses other than slip are relatively low in the water-cooled coupling since there is very little windage loss.

Bearing losses, of course, are approximately normal to any similar type of equipment. Excitation losses are low relative to the size of the machine. On air-cooled couplings, the windage loss is around 3 to 5 per cent depending on speed and application.

In cases where input-output efficiency is of prime importance, drives with multi-speed driving motors have been installed. Thus, when output speed drops below the next lower speed level on the induction motor, the number of motor poles may be changed for the lower input speed, thereby minimizing the slip loss.

A water-cooled eddy current coupling should be considered for any application to a constant torque load. If a relatively narrow constant horsepower range is contemplated, the coupling may also work out advantageously. It is hard to set definite limits because size and speed range of the drive will have a considerable bearing on the feasibility of using the coupling on constant hp loads.

In comparing use of an eddy current coupling with any mechanical adjustable speed drive, such as a variable pitch pulley unit, first cost of the coupling is generally higher than for any normal mechanical type. On the other hand, making speed adjustments on most mechanical type speed changers is a relatively slow process and usually not too accurate. In other words, the eddy current coupling drive has its main reason for existence as an adjustable speed unit in its ability to control speed very precisely and very conveniently. Speed adjustment is made manually by a very small potentiometer, and may readily be combined with special purpose controls.

The eddy current coupling has another advantage in that it may be driven from a mechanical source, such as a line shaft or an internal combustion engine, as the primary source of power. More or less incidental to this, the coupling is also very nearly a perfect torsional damper. Because of its slip characteristics, there is no tendency to oscillate around a synchronous point. The torque pulsations from an internal combustion engine or other source are almost completely dampened. In certain cases this is a very distinct advantage over any friction lockup type.

Water-cooled couplings are all designed with a sufficient heat rejection capacity to accommodate the full motor rating, Table 1, on a continuous basis. Normally couplings are not called upon for such severe duty, which means they would continuously develop rated torque at standstill on the output shaft. However the problem merely resolves itself around the design of the coupling to carry adequate cooling water in order to accommodate such service, and that capacity has been standardized. In general, rated torque is continuously available from zero to full speed.

Size vs Torque Ratings

Couplings are normally rated according to their torque capacity, Table 1, since they may be used with motors having top speeds lower than maximum design speed of the couplings. For a given horsepower capacity, torque varies with rated motor speed making it the important value. However, as a guide for coupling dimensions, water-cooled types are normally somewhat smaller than a motor having a horsepower capacity equal to the dissipation capacity, Table 1.

In the air-cooled coupling, the problem of heat dissipation, of course, is more severe. Air cooling is not a particular problem on very small units. The smallest is a 1 hp size and, up to about 5 hp, couplings can dissipate their entire rated power. As ratings of the machine increases, the relative heat rejection value decreases so that large sizes, around 200 or 300 hp, can be economically designed to dissipate only 20 to 25 per cent of the motor rating. This is sufficient to take care of ordinary fan or centrifugal pump loads.

Large eddy current couplings of the air-cooled type are not recommended where a constant torque range, which would indicate a heat rejection in excess of approximately 20 per cent on a larger size unit, must be covered. Again, it is very difficult to generalize. But since cost of the air-cooled and water-cooled couplings are approximately the same, there is no particular resistance where the latter are indicated except for inconvenience in piping water to the coupling, and they are used in the majority of cases. As a secondary consideration, the water-cooled unit is slightly more efficient and extremely quiet, whereas air-cooled types are bound to be a little noisy at high speed.

Selection Based on Load

Variable torque loads, as commonly understood in the industry, are such as are encountered in application of centrifugal devices of any kind. Outstanding examples are centrifugal pumps working in a fixed system, or centrifugal blowers also operating in a fixed system. On these applications, torque demanded by the machine varies as the square of the speed, and horsepower as the cube. Thus power transmitted drops very much more rapidly than speed and slip losses in the coupling are limited. Maximum slip loss which can be encountered with a centrifugal pump or fan load is approximately 15 per cent of the full speed rating and occurs at two-thirds full speed. At this point, slip is one-half the *output* speed so that the loss is one-half the output power, (which has dropped by the cube of two-thirds, or to 30 per cent of full load). Since the losses are well within the 20 per cent dissipation capacity of the larger air-cooled couplings, fan loads or, more commonly, variable torque loads are ideal for an air-cooled eddy current coupling.

Constant horsepower loads are very commonly encountered, for example, in machine tool applications. Torque varies inversely with the speed over a limited range. In other words, any operation in which torque demand is high when speed is low (or conversely, when torque is low, speed is high) would indicate use of a constant horsepower drive of some type.

In metal rolling, for example, high alloy steel which is relatively hard is usually rolled at a low speed, and the hard metal requires a greater amount of torque. For softer metal, torque demand is obviously lower and, at the same time, it is metallurgically practical to speed up the machine. Under those conditions, a constant horsepower drive would be indicated.

Constant horsepower loads, in general, are relatively scarce and are usually encountered in those cases where operation of the driven machine is not definitely limited to a certain fixed function. Here the constant horsepower characteristic of a drive would help the versatility or over-all usefulness of the equipment. Electrically, the only drive which can very conveniently accommodate a large range (above base speed) by constant horsepower would be a d-c motor operating on field weakening control. In using an eddy current coupling on this type of load, as with a slip ring motor, horsepower capacity of motor and clutch must be the same as though they were operating at full speed with the higher low speed torque. In general, on a larger size unit, in the range of 100 to 500 hp, a constant horsepower speed range of approximately 2 to 1 can be accommodated without seriously handicapping the equipment in first cost as compared, for example, to Ward-Leonard systems with their three units. If the speed range is wider, it is sometimes more economical to go to some other type of drive.

Constant torque loads. By far the greatest percentage of processing applications operate on a constant torque basis, as is generally true where work being performed is used mainly in overcoming friction. A positive displacement compressor is a very good example. Most processing machines, such as paper mill machinery, conveyers, hoists, and similar applications are of the constant torque type, or are at least assumed to be so for a fixed operation.

Obviously any type of machine can be overloaded. However, with a fixed set of conditions, in changing from one speed to another, most machinery operates on a constant torque basis. The eddy current coupling, as well as the wound rotor motor, is ideal for such service. A d-c motor operated on armature voltage control will also accommodate such a load very well.

Again the items of first cost, maintenance, efficiency, and other features must be considered. The eddy current coupling has the control characteristics of the d-c equipment with cost very nearly comparable to that of a wound rotor motor with a fairly elaborate secondary control. Efficiency wise, the slip ring motor and the eddy current coupling would also compare favorably with the d-c equipment from high speed down to approximately 70 per cent maximum. Here efficiency would, in most cases, balance off, with the Ward-Leonard system showing an advantage at lower speeds. Again, this is a very general statement and is dependent on size of machine, speed range, and actual speed of operation.

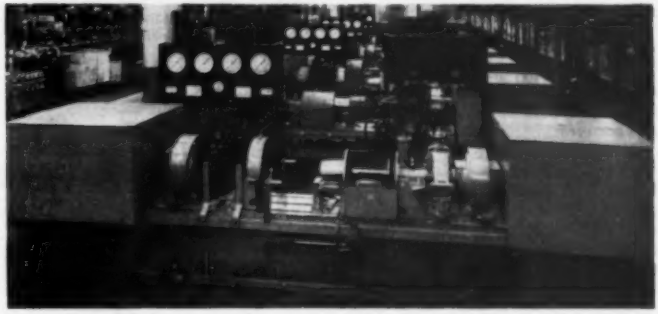
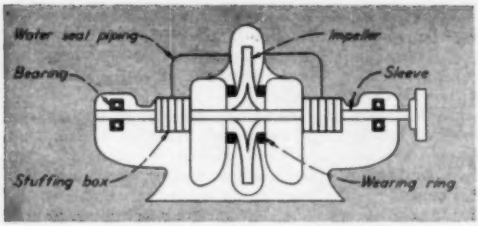


Fig. 6—Within the recommended limits, excellent speed control may be expected from the simple eddy current couplings. With a variety of uses, adaptability is shown by multiple, adjustable speed test units for automobile torque converters

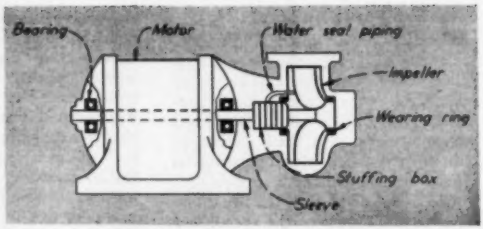
TABLE 1—SAMPLE ENGINEERING DATA ON WATER-COOLED EDDY CURRENT COUPLINGS

	← Torques, ft-lb →								← WK², lb-ft² →	
	← Slip, rpm →				1800 rpm	Maximum	Dissipation	Excitation		
Model	50	75	100	Peak	breakaway	speed, rpm	capacity, hp	needed, kw	Field	Drum
20W	45	53	60	130	130	1800*	30	0.22	7	7
30W	90	125	175	225	200	1800*	60	0.22	15	17
40W	175	225	250	375	275	1800*	100	0.44	25	30
50W	250	300	350	550	450	1800*	150	0.44	46	40
60W	600	800	900	1050	800	1800*	200	0.44	131	184
70W	1000	1300	1600	2100	1650	1800	300	1.10	354	260
80W	1700	2200	2400	2750	2000	1800	500	1.10	570	545
90W	3600	4000	4300	4600	3800	1200*	750	2.00	1080	540
100W	4750	5750	6250	6750	5800	1200*	1000	2.00	2050	1540

*Also available for higher speeds



Double suction pumps, one of four main types, contain the same elements as other three but differ in shape



Single suction pumps are usually built as a unit with the motor and impeller on common shaft, eliminating couplings

COMPLETE DATA MEAN CORRECT PUMPS

The right question and correspondingly correct answer can mean the difference of the improper or proper selection of a pump. Manufacturers have questionnaires whereby men in the field can select a pump that will meet all requirements

JOHN A. CABLE, *Application Engineer*
Centrifugal Pump Dept, Allis-Chalmers Mfg Co.

PUMP SALESMEN have gained the reputation of being extremely *nosey* individuals and not without reason. A pump salesman who is not inquisitive can hardly serve his customers. Thus, he is obligated to ask extensive questions and obtain complete answers.

To make certain that the salesmen overlook no important items, most pump manufacturers have a special form listing important questions. A form of this type investigates what is needed and why. The first four questions are usually classed as *General Information,* but they require specific answers.

Item Number This is especially applicable when a number of items are involved. Proper identification of each unit can make the handling of resulting orders much simpler and thereby prevent errors.

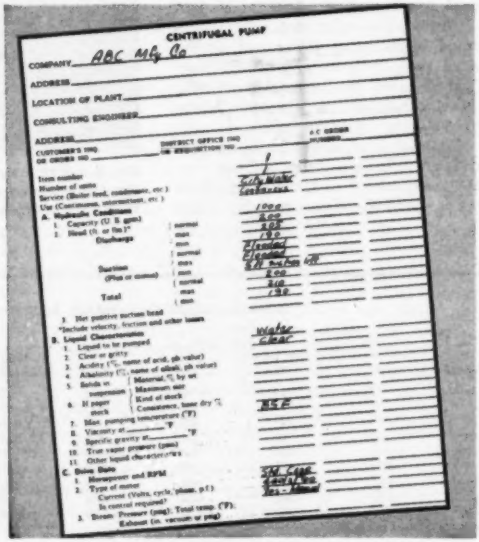
Number of Units When more than one, indicate whether the pumps are for series or parallel operation, or just similar units for independent operation. When the equipment is to be special and development work is involved, this factor can materially alter the unit prices and shipment. If a large quantity is to be ordered, even with standard equipment, the shipping time might certainly be affected, and the price may be less because of mass production economies.

Service This is usually known or can easily be determined. Though many pumps might have the same rating, and thus appear suitable, the type of service will determine the mechanical arrangement and limit the pump choice considerably.

Use Duty expected, whether continuous, batch, or intermittent, will in many cases affect the selection of driving equipment. This is especially true with gasoline or diesel engines, which can be rated considerably higher for intermittent use than for 24 hr duty. Making recommendations for necessary spare parts will also be clarified by a complete answer to this question.

Next group of data, *Hydraulic Conditions,* is naturally the prime requisite for the selection. Though this information is usually given, even without the use of an itemized form, it emphasizes the need for normal, maximum, and minimum values. This makes possible the selection of equipment for operation at variable capacities and heads. When a wide quantity range is desired, the use of more than one pump for a given job is desirable.

Pump manufacturers all have questionnaires similar to the two shown on this page and facing page. Answering these simple questions will aid the manufacturer in either selecting a standard unit or designing one to meet the exact conditions existing the field. The


CENTRIFUGAL PUMP

COMPANY ABC Mfg Co

ADDRESS

LOCATION OF PLANT

CONSULTING ENGINEER

ADDRESS

CUSTOMER'S INQ. OR ORDER NO. | DISTRICT OFFICE INQ. OR REQUISITION NO. | A-C ORDER NUMBER

Item number — 1

Number of units — Fifty Make Continuous

Service (Boiler feed, condensate, etc.)

Use (Continuous, intermittent, etc.)

A. Hydraulic Conditions

1. Capacity (U. S. gpm) — Normal 1000; Max 1100; Min 800

2. Head (ft. or lbs.)* — Discharge: Normal 150; Max Standard Standard; Min 150

Suction (Plus or minus): Normal 2 ft. 9 in. Flooded; Max 2 ft.; Min 2 ft.

Total: Normal 148; Max 150; Min

3. Net positive suction head

*Include velocity, friction and other losses

B. Liquid Characteristics

1. Liquid to be pumped — Water

2. Clear or gritty — Clear

3. Acidity (%, name of acid, ph value)

4. Alkalinity (%, name of alkali, ph value)

5. Solids in suspension: Material, % by wt; Maximum size; Kind of stock

6. If paper stock: Consistency, bone dry % — 3½ %

7. Max. pumping temperature (°F)

8. Viscosity at ____ °F

9. Specific gravity at ____ °F

10. True vapor pressure (psia)

11. Other liquid characteristics

C. Drive Data

1. Manufacturer and RPM — 514 Line; 1440 1170 Rec. Motor

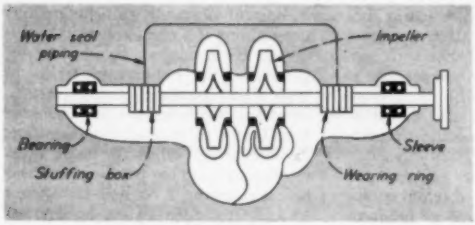
2. Type of motor

Current (Volts, cycle, phase, p.f.)

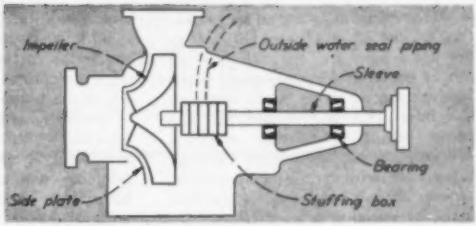
Is control required?

3. Steam: Pressure (psig). Total temp. (°F).

Exhaust (in. vacuum or psig)



Multi-stage pumps, containing two or more impellers, are employed when liquid must be delivered at high pressure



Open impeller pumps are installed in systems that have paper stock, sewage, or other materials in the liquid

An illustration of this situation is the case in which the minimum rate is 50 per cent or less of the maximum rate, and the service requires this lower capacity a large part of the time. This is a logical spot to consider two pumps —one to carry the minimum load, and the combination to handle the maximum load in parallel. Such an arrangement might require a higher initial outlay, but the lower efficiency attending partial load operation should certainly be considered for the over-all cost comparison. Any number of such partial capacity problems can exist, and in each case an alternate arrangement of multiple pumps should be examined for relative economy.

Any changes in conditions, which can be foreseen, such as capacity and head should be indicated. Capacity and total head requirements determine the size and operating speed. Another point to consider is that for a given capacity a smaller pump at a higher speed may be used to develop a high head, whereas a larger pump with a lower speed will be required to supply the same output at a lower head. These three conditions — capacity, head, and speed — are interdependent, and one cannot be considered independent of the other two.

Capacity Standard ratings should be given in US gpm, or the basis for rating specifically indicated. An often repeated indefinite statement is, *Quantity to be handled per day*. This alone does not tell the supplier whether the *day* is to be 8, 16, or 24 hr. Effect on pump size, as can be seen, would be greatly influenced by this factor. In addition to giving the capacity on a specific basis, the purchaser should give the operating temperature of the liquid pumped.

Slightly over-rating the capacity to assure desired capacity after some wear has taken place inside the pump is common practice. One point to watch is that increased capacity will increase friction so that corresponding head requirements change—possibly to such an extent that over-capacity operation cannot be reached. Since a pump produces less head as capacity increases, both capacity and head must be considered when assuming that even a slight change in output can be accommodated by a given pump.

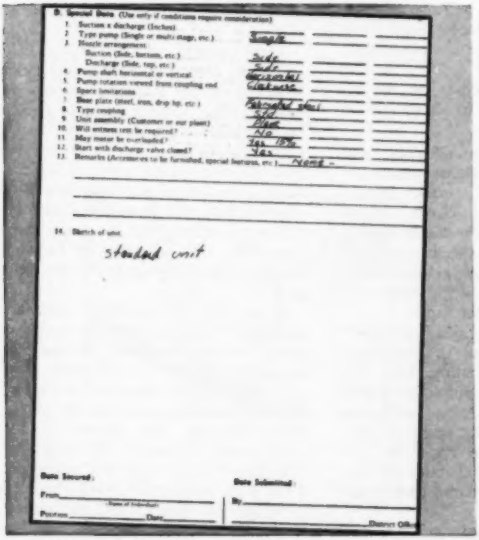
Head Pressure required on the pump discharge is usually information readily at hand. All too often, however, conditions on the pump suction are haphazardly given. These conditions are always of prime importance, and the necessity of complete information cannot be over-emphasized. With ordinary pumping of cold water the suction limitations can be readily compared to requirements and capabilities of pumps. This is possible because testing is done, and data are tabulated on this basis. As soon as there are any changes in temperature and vapor pressure, however, all factors must be weighed more deliberately.

For example, a pump that could lift cold water 15 ft would not operate on boiling water unless there was a positive suction head of 19 ft. When liquids, such as gasoline, are handled, this difference in suction lifting ability might limit applications even at ordinary outdoor summer temperatures.

In many cases analyzing the head requirements to compare the price of pumping equipment with the piping as designed will pay dividends. Possibility of increasing pipe sizes to reduce friction heads and make smaller, cheaper pumps suitable is one that should not be overlooked.

Net Positive Suction Head This is the description of suction conditions that takes all factors into account. When this value is given a suitable pump can be selected for operation at less than the available NPSH.

Next major group, *Liquid Characteristics*, is equally important, especially when the liquid pumped is other than clear, cold water. Most items in this group are cut and dried facts and are, therefore, easily ascertained in


D. Special Data (Use only if conditions require consideration)

1.	Suction x discharge (Inches)		
2.	Type pump (Single or multi-stage, etc.)	Single	
3.	Nozzle arrangement:		
	Suction (Side, bottom, etc.)	Side	
	Discharge (Side, top, etc.)	Side	
4.	Pump shaft horizontal or vertical	Horizontal	
5.	Pump rotation viewed from coupling end	Clockwise	
6.	Spare limitations		
7.	Wear plate (steel, iron, drop hp, etc.)	Furnished steel	
8.	Type coupling	Std	
9.	Unit assembly (Customer or our plant)	Plant	
10.	Will witness test be required?	No	
11.	May motor be overloaded?	Yes 10%	
12.	Start with discharge valve closed?	Yes	
13.	Remarks (Accessories to be furnished, special features, etc.)	None	

14. Sketch of unit.

Standard unit

Date Secured: Date Submitted:

From: (Name of Individual) By:

Position: Date: District Office

order of arrangement of the questions may vary with each company, but the data requested will follow the same pattern in each instance. Correctly filling out such a form will be the first step towards the proper selection and ultimate good pump service

most cases. The main reason for knowledge of the liquid characteristics is to provide a basis for the selection of proper materials for the various parts. In the majority of cases the prospective buyer can, and should, tell the pump manufacturer what materials will best suit the application. Previous experience with process equipment, piping, fittings, and tank is the best basis for selection of materials.

Liquid to be Pumped Frequently the name of the liquid alone tells enough of the story to complete the description when the temperature and specific gravity are known. Occasionally, however, the process is a closely guarded one, and the description will be limited to something like *an organic liquid handled like water*. For those applications, more complete data in the other categories of this group are necessary.

Clear or Gritty When the the answer to this question is gritty, the solid particles must be identified along with the liquid medium.

Acidity or Alkalinity Headings for these two are self-explanatory. In either case, if more than one acid or alkali is present, all data should be given for each material.

Solids in Suspension When the liquid is not clear, the particles identified under *Clear or Gritty* must be classified according to per cent by weight and maximum size. This information is definitely necessary, for large abrasive particles usually require a pump with hard, abrasion-resistant materials. Smaller particles are usually handled best by rubber-lined pumps.

If Paper Stock This is a strictly specialized application requiring exact information to assure proper pump selection. The two factors, namely *kind of stock* and *consistence* must be exactly stated as the various types of stock often handle differently even at equal consistencies. Contemplated developments might also alter this picture somewhat, as limitations of pumpable consistencies have been extended from 5 and 5½ to 8 per cent through auxiliary equipment installed ahead of the pumps.

Maximum Pumping Temperature An appreciable range between the minimum, average, and maximum calls for giving all values. With a liquid, which is easily vaporized, like gasoline, the maximum temperature is of most importance. Inversely, the more significant specification for a viscous oil pump is the minimum temperature due to the viscosity-temperature relationship.

Viscosity In this country the usual measure of viscosity is in Saybolt Seconds Universal (SSU or SUS). If otherwise designated, the standard used should be specified. Viscosity data should be given for all temperature conditions encountered, but with specific reference as to the temperature at which the pump is to be rated.

Specific Gravity This also should be correlated with any possible temperature changes. Specific gravity data are primarily required for selection of horsepower range of driving equipment, and for calculation of heads in feet where the pump output pressure is given in psi.

True Vapor Pressure Vapor pressure is significant because it affects suction conditions. Many liquids will have no appreciable vapor pressure at pumping temperatures, but hydrocarbons—and similar liquids—have vapor pressures, which strongly influence the permissible suction head.

Other Liquid Characteristics This is for the description of unusual liquid properties. For example, the liquid might gelatinize when idle in the pump. It might produce scale or even solidify around pump parts. These characteristics make special mechanical features advisable for maintenance or actual operation (such as axial clearance wearing surfaces).

The *Drive Data* group of questions is usually quite easy to answer. However, the answers given are important to proper pump and drive performance and life.

Hp and Rpm Inquiries are seldom received wherein the horsepower is specified in advance unless existing equipment is to be utilized. Frequently, however, a preference for a specific rpm exists. Pump manufacturers can always attempt to provide pumps for a specified speed and will use an existing drive where possible. Suggestions are requested about permissible changes in head and capacity so that the drive can be used when the requested rating cannot be obtained with a certain drive.

Type of Motor Squirrel cage, slip ring, and synchronous type motors are each best adapted to specific pumps. Usually, head-capacity charts are set up for 60 cycle induction motor speeds, and any change in speed materially alters the range of ratings obtainable. With synchronous motors, the data must include the power factor.

In many borderline cases, final selection of motors is made on the basis of permissible temperature rise, insulation, and type of protection (such as drip-proof, open, or totally-enclosed). As far as the pump is concerned, however, the cycle or frequency of the current dictates the operating speed (when pump and motor are direct-connected).

Required starting characteristics and manner of operation are important in determining the necessary starting torque to be developed by the motor. Generally, the ordinary moderate to high head centrifugal pumps are started with a valve closed in the discharge line. Under these conditions the starting horsepower, which the motor must develop to bring the pump up to speed before throwing it on line, is between 35 and 60 per cent of the horsepower required at rated pump load.

For low to moderate heads where mixed or axial flow type pumps are used, the shut-off (zero capacity) horsepower equals and often exceeds the horsepower required at the pump operating point. With mixed flow pumps, this may be 100 to 150 per cent of bhp at rated load, and with axial flow type pumps it may be as high as 300 per cent. In the latter cases, motors with extra starting torque or special starting arrangements (such as automatically controlled valves for the pump discharge line) are required.

When the drive is a gasoline or diesel engine another type of data are required. When the pump manufacturer is to quote on the engine, he must know such things as where the unit will be installed (so as to provide proper weather protection), type of starting accessories desired, and mufflers. As mentioned under *use*, the time cycle of operation is required since engines are rated about 25 per cent lower for continuous duty than for intermittent or stand-by operation.

Steam For steam turbine-driven equipment this information is readily obtainable, but it should be complete and accurate. Here, again, any future changes that are planned should be outlined.

Final category entitled *Special Data* is, for the most part, used very seldom. When there are special requirements, however, they require equal or greater consideration than the specific requisites previously outlined. When, for example, the request covers a replacement pump, many of these restrictive specifications will be required to meet existing conditions. Of the many items covered by this category, the last one *Remarks* will probably be the one most used.

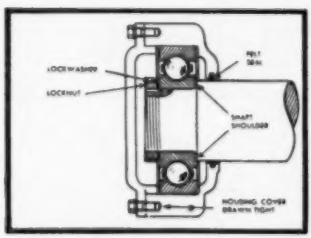
If any of the pertinent data are omitted a poor selection will probably result, unless someone happens to make the correct assumptions. The more a customer cooperates in supplying the complete, correct answers to these questions, the greater is the manufacturer's chance of supplying equipment for satisfactory operation. To a great extent, therefore, the buyer *writes his own ticket* for service received.

Power transmission

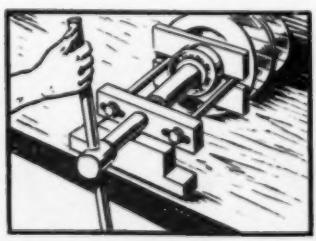
Engineering data and information to aid in selection, application and operation of equipment used in transmission of mechanical power

DO AND DON'TS FOR BEARING

JOSEPH L. BRUSCA,
Sr. Design Engineer
SKF Industries, Inc.

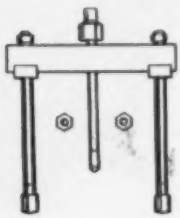


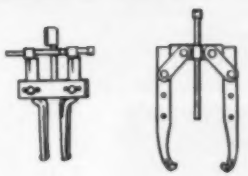
Be sure bearing is square with and held firmly against shaft shoulder by securing it with a lock nut and lock washer. Housing covers must be tight to keep lubricant in and dirt out. After held bearing has been properly positioned, the free bearing should be located centrally in its housing to permit expansion and contraction of the shaft.

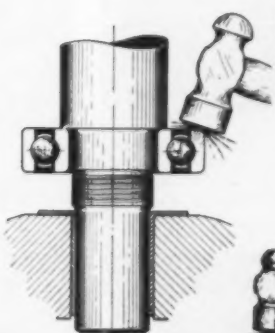


When removing a bearing from a shaft, the inner race is forced with press or draw bar and plate. Shaft shoulder must be smaller than the inner race to make such removal. Specialized tools utilized will more than pay for themselves by preventing damage to serviceable bearings.

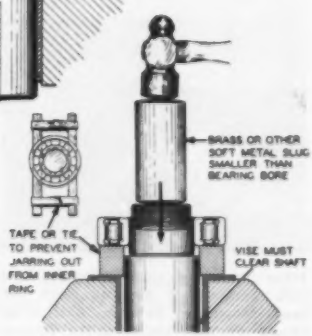
Arbor press is equally good for mounting or removing bearings. Bearing pullers may be employed separately or in combinations to pull or push bearings or individual rings into position





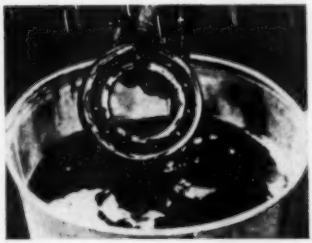


Never pound directly on a bearing or ring. It will likely damage either or both the shaft and bearing

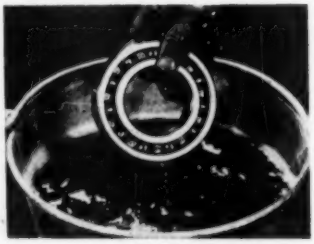

BRASS OR OTHER SOFT METAL SLUG SMALLER THAN BEARING BORE
TAPE OR TIE TO PREVENT JARRING OUT FROM INNER RING
VISE MUST CLEAR SHAFT

To drive shaft out of bearing, employ a soft metal slug, which will not mar shaft or thread

Bearings should not be spun before they are cleaned. Abrasive dirt can cause serious scratching to balls and races that will lead to early failure



To obtain best results the bearings should be soaked in plenty of solvent. Period of soaking time depends upon condition and appearance of bearing



After the dirt on and in the bearing has been thoroughly soaked it should be rinsed in clean solvent, light oil, or kerosene to flush out the particles

INSPECTION and ASSEMBLY require clean bearings.

Condition of a bearing should not be judged until after it has been cleaned.

Don't spin dirty bearings. Rotate them slowly while washing. Rotate on ring by hand to expose all points.

Bearings with a shield or seal on only one side, should be washed, inspected, and handled similar to unshielded bearings.

With shields or seals on both sides do not wash, but wipe off to keep dirt from working inside. Bearings that turn smoothly should be coated with protective lubricant, wrapped, and stored or returned to original application.

Soaking and washing a bearing can be accomplished in a small tank and wire basket, clean grease can, or bucket filled with solvent. Soak the bearing long enough to loosen all grease and dirt. Slosh bearing around near top of the container, turning it about frequently until clean. Rinse in a clean container of clean solvent.

Kerosene or gasoline is generally employed as a cleaner, but petroleum solvents designed for that purpose are preferred. Gasoline containing ethyl or other anti-knock compounds are poisonous when absorbed into cuts or inhaled and should be avoided.

Short, clean brushes with firmly embedded bristles are an aid in removing dirt, scale or chips.

Bearings passing inspection but not reassembled in equipment at once, should be dipped in slushing compound and stored in a covered pan.

When inspected bearings are to be stored, they should be dipped in a protective lubricant or coated with a light grease. Rotate rolling parts and race ways in grease to assure proper coating. Then wrap in greaseproof paper and place in a clean box or carton. If cartons are not available, wrap in waterproof paper, marking package for easy identification.

Bearings partly assembled should not remain exposed. Cover the assembly to prevent damage by moisture, dirt, or other foreign matter. Any clean cloth or paper will adequately serve this purpose.

DO and DON'TS on lubrication

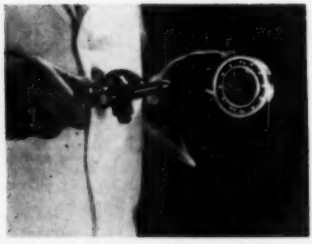
Follow machinery instructions when furnished. Do not substitute grease for oil nor oil for grease, but follow specifications.

Store grease in clean containers and handle it with a clean paddle or grease gun. Grease containers should be covered.

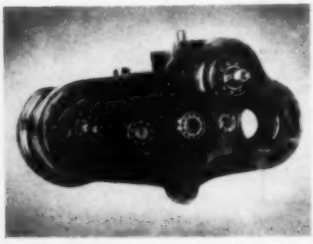
Don't over lubricate as grease or oil oozing from housings collects dirt and invites trouble. Too much lubricant in bearings running at high speeds results in churning and abnormal heat.

Idle machinery should be rotated occasionally so that all surfaces of the bearings will be covered with lubricant. Oil tends to drain down off an idle bearing and moisture may condense in the housing causing corrosion.

Inspect seals and vents regularly.



When removing excess rinsing fluid with compressed air the balls nor races should not be spun. Both rings should be held between the fingers



Bearings that are partially assembled in a machine might collect harmful dust or dirt if left to stand over a long period. Moisture may also enter

Covering the assembly with clean cloth or paper, especially if it is not to be worked on until the next day will help keep the bearings clean and dry

No Pressure Wipe-Off on Gears Lubricated with Sun 897 Grease

Even heavy tooth loading won't cause Sun 897 Adhesive Pressure Grease to squeeze out. It stays on the gears, prevents metal to metal contact, prolongs gear life, and reduces lubrication costs. Sun 897 is most valuable where *throw-off* with resultant wear and spotting of products must be avoided. It is easily applied with a brush on open gears, sprockets, chains, slides, cams, cables, couplings and linkages. For complete information, consult your nearest Sun representative or write Department IP-12.

SUN INDUSTRIAL PRODUCTS
SUN OIL COMPANY • PHILADELPHIA 3, PA.
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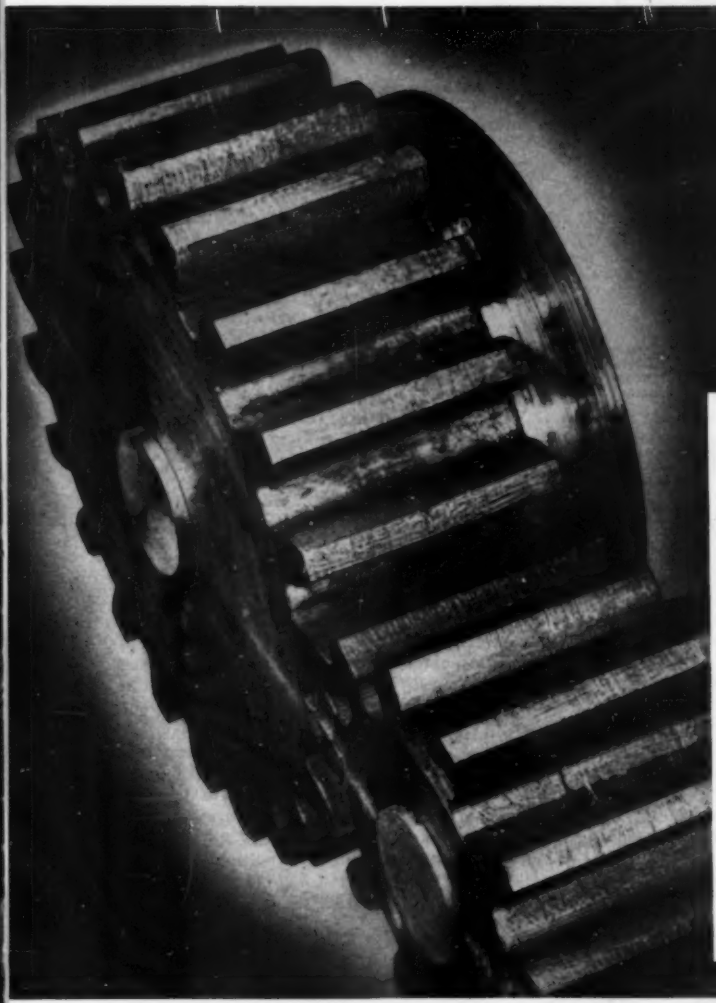
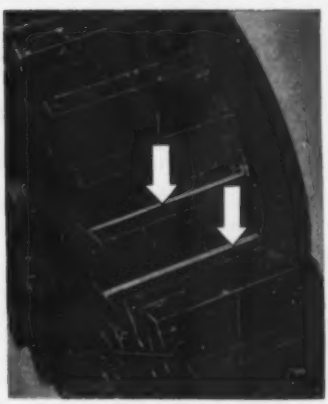
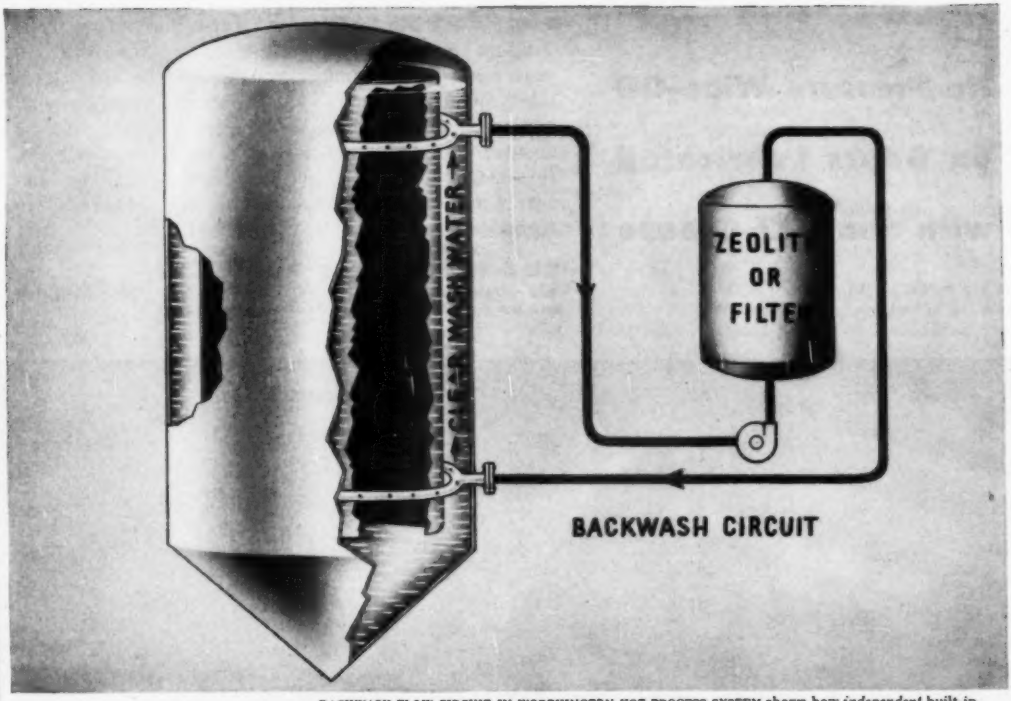




BLACK GEAR COMPOUNDS oxidize, harden and wipe off quickly under pressure. Arrows indicate where wipe-off of the compound has left the gears unprotected by a lubricant. Metal to metal contact causes excessive wear and thus materially shortens the life of gears.

NO SQUEEZE-OUT due to pressure. A thin, transparent film of Sun 897 Adhesive Pressure Grease stays evenly distributed on the gears and gives positive lubrication at all times. Sun 897 is water resistant and can be easily applied with a brush.



BACKWASH FLOW CIRCUIT IN WORTHINGTON HOT-PROCESS SYSTEM shows how *independent* built-in, annular wash-water compartment* provides clean, hot, chemically inert water for backwashing and reclaims it without affecting operating velocities in treating zone, or subjecting hot zeolite to temperature changes. Backwashing is accomplished by recirculation of the clarified wash water.
*Reg. U.S. Pat. Off. 2,263,398

You can't wash clean with dirty water!

How Worthington Hot-Process Water-treating systems backwash with CLEAN, hot, chemically inert water

When you're considering hot-process water-treating systems with hot zeolite, filters, or both, *don't overlook backwashing facilities.*

They must be well designed, or the system cannot give smooth, efficient, trouble-free performance. Worthington engineers recognized this fact when they designed their first hot-process system. Today, every Worthington standard Hot-Z or conventional system provides exclusive *independent* facilities for backwashing zeolite or filters with clean, hot, chemically inert water without disturbing the normal flow through the reaction bank.

Worthington water-treating specialists don't believe you can wash clean with dirty water.

This unique backwashing provision is just one of many Worthington patented features, but it alone will more than justify your selection of a Worthington system for hot-processing boiler feedwater in your plant.

If you have a problem, whether it involves filtration, precipitation, or zeolite treatment, Worthington specialists will be happy to study your water-treating problem and recommend the proper system. Just write, stating service conditions in detail, to Worthington Corporation, Water Treating Division, Harrison, N. J. J-2-1

Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON
Water Conditioning

Handbook for engineered plant services

Methods, data and ideas that make excellent references in solving engineering problems frequently encountered in plant operations

Selection and Application of

MODERN INDUSTRIAL CABLES

CABLES for industrial use are manufactured according to various national standards where they are applicable or, otherwise, to manufacturers' specifications. The table on the next page briefly shows application of various insulations on cables for industrial plants. Detailed information is available from the manufacturer.

Manufacturing Plants

Cables between buildings might normally be placed underground. Difficult installation conditions likely to be encountered include steam and air lines, foundations, railway tracks, tunnels, heavy trucking loads on the surface, corrosive waters, and others. Standard and special rubber compounds, thermoplastic, paper, and varnished-cambric insulations all are used. Standard duct construction is preferable for important feeders, especially in multiple runs.

If duct construction is unnecessary or difficult, cables may be buried directly in the ground using a metallic-armored type with either two flat steel or one interlocked steel tapes. Nonmetallic armored types may also be used. The former provide better mechanical protection and usually need no further covering except at points of heavy traffic or near steam lines. Most widely used nonmetallic armored cable for voltages to 5 kv is a rubber insulated, neoprene jacketed cable with either single or multiple conductors.

Up to 600 v, cables insulated or jacketed with vinyl resin are suitable. Both types need no further protection against most corrosive waters and, otherwise, only at points noted above.

Abstracted by courtesy of Anaconda Wire and Cable Co. from general catalog No. C-79. Because of its wide general interest, this material was selected from the catalog, which gives detailed information on all common cables including types not made by the company. See New Bulletins.

For corrosive conditions underground, lead covered cables may be protected by a reinforced neoprene hose-type jacket.

When underground construction is difficult, many plants place cables aerially on racks, cross arms, or self-supported by a messenger. For open wires on insulators, bare, weatherproof or covered line wire types are common, the last two being used when subject to fumes. For insulated cables with a messenger, rubber insulated, neoprene jacketed or lead alloy covered types are satisfactory. The lead type is used with a protective covering if subject to fumes.

Indoors, in buildings having bus duct systems, a bus drop cable is ideal for take-off's to individual machines. The first construction approved by Underwriters' Laboratories, Inc. for this purpose is described in the table.

Main and branch feeders and individual circuits, 600 v and lower, are installed with a variety of cables. Choice is dependent upon a number of items, the principal ones being listed in the table.

Chemical Plants

Special problems arise in these plants, often because of corrosive fumes and waters. For such cases, braid covered cables, whether in the open or in conduit, are subject to braid deterioration, and often to rubber insulation failure.

Possibly no one cable will be satisfactory in chemical plants having particularly severe exposures. But a great many troubles have been eliminated by thermoplastic insulated cables without braids. Their resistance to a long list of chemicals and fumes is well known after years of service. Vinyl resin thermoplastic often does an excellent job. In other cases, polyethylene is satisfactory, but this insulation is still a specialty type.

Conductor temperature for cables insulated or jacketed with thermoplastics and used in chemical plants should be considered carefully in selecting conductor size. Any chemical attack on insulation or jacket is somewhat accelerated at higher temperatures. Also, the insulation has a slight tendency to deform. Recommended limits are 60 C for vinyl resin and 80 C for polyethylene.

Conductor corrosion has been eliminated in some chemical plants by employing a wire coated with tin or proprietary lead-tin alloy, though thermoplastic and varnished cambric insulated types ordinarily do not require coating. Neoprene jackets have almost completely supplanted saturated cotton braids over rubber insulated wire and cable for industrial and chemical plant wiring. These usually are in the form of an extruded jacket for nonleaded constructions. The use is widespread because of their superior qualities for this job. They have toughness, high resistance to abrasion, good weathering record in aerial installations, as well as high resistance to acids, alkalies, many chemicals and petroleum products.

Reinforced hose-type neoprene jackets over leaded constructions provide excellent protection against corrosion and electrolysis and are superior to duck tapes or ordinary servings. Vinyl resin jackets over nonleaded constructions also protect against chemicals and petroleum products.

Control cables with polyethylene or vinyl resin insulation and jacket have been very successful in chemical plants. They have continued to function in some cases long after the metallic conduit or duct system was destroyed.

Steel Mills

Many problems arise in steel mills from moisture, flooding, corrosive waters, heat concentration, temporary circuits, crowded ducts and conduits and others. Most problems can be solved with existing cable constructions.

Some mills use vinyl resin thermo-

plastic insulation exclusively for low voltage circuits and the same type insulation and jacket for control cables because of the superior characteristics. There is nothing fibrous to deteriorate or retain moisture. The cables are easy to pull, and they save space, reduce conduit sizes, withstand chemical and mechanical abuse, and are unaffected by moisture.

Laid in the open, the jacket stands up under impact and abrasion and can be relaid for another job. As with rubber insulated, neoprene jacketed cables, vinyl resin is flexible and easy to handle both as insulation and jacket. Individual conductors of rubber insulated control cable need not be jacketed to eliminate moisture wicking.

Polyethylene insulated control cable with vinyl jacket is highly satisfactory for d-c circuits in wet locations.

For motor circuits installed in conduit, Type ANW* rubber insulation with neoprene jacket is recommended up to 2,000,000 cir mils. Type ANW is both a moisture and heat resistant insulation, recommended for 75 C maximum copper temperature (60 C in wet locations under NEC jurisdiction). Jacketed construction is designed for wet locations, the neoprene also giving extremely good protection against oils and similar deteriorating agents. This type is also preferable for d-c circuits in wet locations.

Refineries and Tank Farms

Cables in refineries and tank farms naturally will be exposed to petroleum products. In these cases, high resistance of vinyl resin to most oils, greases, gasoline and other products (both as insulation and jacket) is a great asset in its favor. It is used now in both types of plants for power and control circuits. Control cables are also jacketed with the same material. Some tank farms use vinyl resin insulated wires and cables exclusively.

*Anaconda registered trade name.

COMMON INDUSTRIAL CABLES — GENERAL CHARACTERISTICS AND APPLICATIONS

General application	Description	Voltage rating	Application
Building wire and cable	Rubber, Type R	600	General purpose power and lighting, minimum quality
	Type RH	600	General purpose. Greater current rating; longer life
	Type RW	600	General purpose. For moist locations
	Type RU	600	General use. Saves space
	Thermoplastic, Type T	600	General purpose. Saves space, resists oil, grease, fumes, acids, alkalies; no braid to deteriorate
	Thermoplastic, Type TW	600	Same as for Type T. For use in moist locations
	Nonmetallic sheathed	600	Open or concealed wiring, lighting and power
Power cables, thermosetting insulation for above 600 v	Heat resistant rubber	2000	General purpose, neoprene jacket or with lead sheath and protective jacket for moist, flooded or corrosive locations. High reliability, long life
	Ozone resistant rubber	15,000	General purpose. Coverings and applications as above
	Heat and ozone resistant rubber, neoprene jacketed	15,000	General purpose. Resists moisture, acids, alkalies, corrosive waters, oils, grease, abrasion. High reliability, long life. Used for secondaries, distribution, high voltage feeders **Check for shielding requirements**
Power cables thermoplastic insulation	Vinyl resin	600	General power use. High resistance to oils, acids, alkalies, will not burn, tough insulation, no covering
	Polyethylene	5000	Special applications, not over 80 C copper temperature
Power cables, varnished cambric insulation	Single and multiple conductor, shielded or nonshielded	28,000	Power, lighting and control. High reliability, flexibility, long life; braid or lead in dry locations, lead in wet locations, with or without potheads up to 7500 v; adapted to long vertical runs; suitable for 2300 to 15,000 v
Power cables, paper-lead, solid type, gas filled type	Single or multiple conductor, shielded or nonshielded	69,000	Power in moderate and large blocks. Highest reliability; must be lead sheathed and terminated in potheads. Minimum over-all diameter for a given conductor size. Highest dielectric strength, permissible conductor temperature and efficiency. Longest life. Most suitable for 11,000 v up
Control cables, thermoplastic, thermosetting, and varnished cambric insulation	Vinyl resin	600	With jacket of same material. Excellent for this service. Resists moisture, acids, alkalies, corrosive waters, oils, etc. No braid
	Polyethylene	600	With vinyl or Type FR* (flame retardant plastic) jacket. Excellent for this service. High dielectric strength and insulation resistance. No braid
	Varnished cambric	600	Long life, high reliability. Braid or lead in dry locations, lead in wet locations
	Rubber	600	RW-RH (Type ANW*) insulation, neoprene jacket or braid in dry locations, neoprene jacket or lead sheath in wet locations. Excellent heat, moisture resistance, long life, high reliability
Special applications	Bus drop cable	600	Three or four conductor, rubber insulated cables (one uninsulated neutral), braid over all
	Flexible cords	300	Types SJ and SJO cords. Two, three and four conductors with special stranding and neoprene jacket for hard service. Resists oils, gasoline, greases, impact and abrasion
		600	Types S and SO cords. Two to six conductors with special stranding and neoprene jacket. Same as Types SJ and SJO, but for heavier service
	Machine Tool Wire	600	Vinyl resin thermoplastic. No braid, saves space, resists oil, grease, acids, alkalies, moisture, corrosive waters and fumes. Has long life, high reliability. Solid for switchboard wire, stranded for control wire
	Arc Welding Cable	...	Special flexible stranding, combined neoprene insulation and jacket
	Asbestos	300	Types A, AA, and AI for hot, dry locations, for leads to or within apparatus. Not for general use
	Asbestos	600	Type AIA, dry locations, to or within apparatus only. Not for general use
	Asbestos varnished	5000	Types AVA, AVB, dry locations only. General use, hot locations
	Cambric	5000	Type AVL (lead covered). Wet locations, general use, hot locations

—ONE JOHN ZINK JZ STOP—
BURNER SERVICE

Between - the- Tube BURNER

The application of the John Zink patented ST Gas Burner to industrial or power boiler installations is a radical improvement in boiler firing.

It is not necessary to form the tubes around the burner to secure maximum heating efficiency. Flame contact is equalized along all heating surfaces.

Furnished in groups of heads. Fires directly over stoker.

JOHN ZINK now offers to industry a sealed port type BURNER for operation on 100% Primary Air

COMBINATION GAS & OIL BURNERS FOR EITHER VERTICAL or HORIZONTAL FIRING

SERIES CBM

Full rating may be taken with completely satisfactory fires with either fuel.

Both fuels may be fired in combination if necessary.

A new file and register design permits operation at low excess air.

Any gaseous fuel at pressure in excess of 5 lbs. may be burned.

Any commercial grade of fuel oil may be burned when properly prepared.

CBM

SERIES Y & SERIES YC

John Zink Series Y and YC Combination Gas and Oil Burners are particularly designed for boilers and process furnaces where maximum heat release at low excess air and high heat density place a premium on reliable burner performance at low first cost.

MAXIMUM DUTY — MINIMUM DRAFT.

RUGGED WEATHER-PROOF CONSTRUCTION.

SIMPLE IN DESIGN.

LIGHT-WEIGHT FUEL GUNS ARE EASY TO REMOVE.

BURN ANY COMMERCIAL FUEL OIL.

BURN ANY GAS AT REASONABLE PRESSURE.

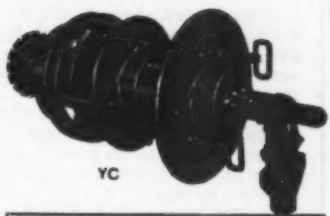
DRAFT MAY BE NATURAL, INDUCED OR FORCED.

CHROMIUM ALLOY STEELS FOR HEAT & CORROSION RESISTANCE.

CENTER FIRING WITH BOTH FUELS ASSURES EQUALLY SATISFACTORY OPERATION WITH EITHER FUEL.

ANY AIR TEMPERATURE MAY BE USED.

Y



YC

WRITE FOR LITERATURE

BE SURE TO ASK ABOUT OUR NEW SMOKELESS FLARE BURNER

JOHN ZINK COMPANY

4401 South Peoria **Phones 7-3323-4-5** **Tulsa 5, Oklahoma**

Spot news

Short, "boiled-down" paragraphs on the most interesting recent events and developments in American industrial plants

Dimming of Fluorescent Lamps Increases Versatility

Since the inception of fluorescent lighting, engineers have been striving for a practical system for dimming fluorescent lamps smoothly and efficiently. Such a system was announced and demonstrated at the recent annual technical conference of the Illuminating Engineering Society.

By means of a new control system developed by General Electric engineers, the brightness of fluorescent lamps can be controlled with the turn of a knob. It consists of a dimming control unit and especially designed matching ballast. By means of a circuit which maintains starting voltage but changes current to affect light output, lamps can be turned on instantly at any point in the dimming range. Units can be dimmed from maximum brightness to practically no light, and then may be brightened in the same manner. The engineers also pointed out the fact that fluorescent lights maintain their original color during the dimming process, while the light of filament lamps turns increasingly red.

Plans to produce the control system are in progress. It will be available for use with either the conventional 40 w pre-heat type of lamp, or with the new 40 w Rapid Start lamps. Two sizes will be produced for operating up to 8 or up to 35 lamps.

The Cover-Oil and Gas Conservation

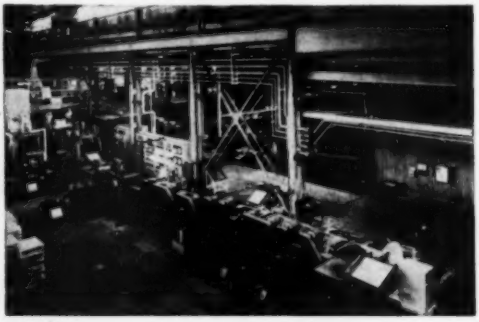
A step in the conservation of the nation's oil resources is being performed by this line-up of Cooper-Bessemer 10-cylinder, 1350 hp Type GMV compressor units, shown in this month's cover illustration. This line-up has recently been enlarged by five more compressor units. After the plant has separated crude oil from gas and extracted the propane, butane, and natural gasoline, the dry gas enters the compressors from the absorbers. The gas is then compressed in two stages from 900 to 4400 psi and returned to the producing formation where it maintains pressures and assists in driving more oil to the surface.

The first large project of its type in Oklahoma, the new Elk City plant, is operated by the Shell Oil Company in behalf of itself and eleven other oil companies. The plant is designed to handle 150 million cu ft of gas daily that is drawn from the unitized area of 201 forty-acre tracts. The process will increase the recovery of liquid hydrocarbons by millions of barrels.

Compressor facilities have been installed to inject 135 million cu ft of gas daily to the Elk City field producing formations.

World's Fastest Vertical-Acid Tinning Line Begins Operation

Operation of the world's fastest vertical-acid type electrolytic tinning line has begun at the Fontana, Calif. plant of the Kaiser Steel Corp. Rated at 1200 fpm, it will



produce more than ten 2 ft long sheets of tinned steel per second.

The complete electrical system for the installation, including photoelectric loop control for the strip-propelling phase of the operation, and controls for the electrolytic cleaning, pickling, plating, reflowing, and chemical-treatment processes, was furnished by General Electric Co. The entire process is reported to be automatic.

Two giant control panels, each over 90 ft long, are used to regulate the a-c and d-c sections of the tinning line. High and low voltage distribution switchgear are incorporated in the control panels.

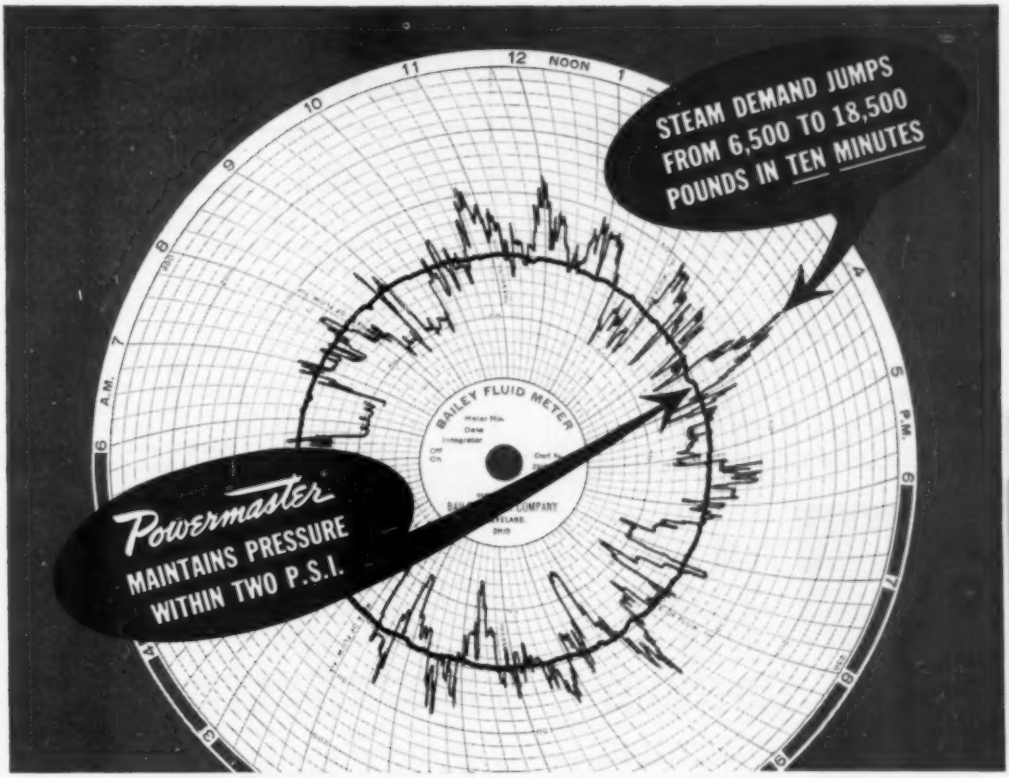
Two 1500 kva transformers furnish power for the flow-brightening equipment. A 60,000 v power pack supplies the electro-static charge for oiling the strip after it has been tinned. Other electrical equipment includes motors, motor-generator sets, transformers and instrumentation.

Also employed in the new installation is a beta-ray gage—its first application on a continuous tinning line. This non-contacting gage continuously and automatically monitors thickness of the tin plate as it passes through the line. In addition, a detector is used to check the strip for pinholes and other imperfections.

Exposition Will Show Latest Heating, Ventilating and Air Conditioning Applications

Many of the latest developments in heating, ventilating and air conditioning equipment will be displayed among the nearly 400 exhibits planned for the 11th International

(Continued on page 110)



Performance records prove *Powermaster's* VORIFLOW combustion responds immediately to steam demand . . . and at full efficiency

At a large southern cotton mill, two 300 h.p. POWERMASTER boilers are generating steam 'round-the-clock at a constant pressure of 100 p.s.i. Note how evenly this pressure (blue line on chart) was maintained even though steam demand (red line) varied from a low of 3,000 pounds per hour to a high of more than 18,500. Between 3:30 P.M. and 3:40 P.M. the load nearly tripled . . . but the POWERMASTERS responded immediately with insignificant pressure change and no "hunting".

This kind of performance is possible because of POWERMASTER's exclusive VORIFLOW combustion. Here's what it will do for you:

1. Saves fuel by providing infinitely variable combustion modulation in response to demand—with *full efficiency*—through wide range from 30% to 100% of firing capacity.

This means elimination of waste and maintenance headaches because of incomplete combustion. The VORIFLOW air-atomizing oil burner does away with outmoded mechanical spinning devices, globules of wasted oil, and gummy cleaning problems. The VORIFLOW gas burner is an O&S pre-mix design equally efficient at all firing rates between 30% and 100% loads.

2. Slashes boiler maintenance costs.

The burner has *no* moving parts to wear out • There is *no* cup to clean daily • Routine cleaning of the burner once a month is sufficient • There is *no* burner vibration to throw adjustments "out of whack" • Parts are made of stainless steel, brass, and beryllium copper—they will last indefinitely.

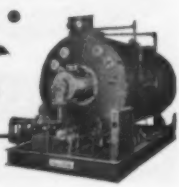
3. The combination burner permits rapid change-over from one fuel to another—light oil, heavy oil, or gas.

Before deciding on a boiler for your plant, be sure to get the facts on the newest POWERMASTER with VORIFLOW combustion. Write for this catalog that gives you the entire story of the *Powermaster* packaged automatic boiler. Just drop us a line and we'll put one in the mail for you.

Powermaster

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.



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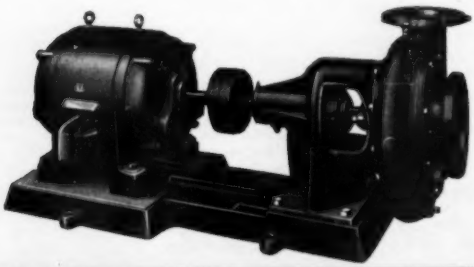
for pumps ...call a WEINMAN PUMP SPECIALIST

To get a job done right, it's best to call a specialist. WEINMAN specializes in building and supplying pumps that are right for your needs. That's because WEINMAN is dedicated to service, and for more than 50 years, has helped industries find a practical solution to their liquid handling problems. WEINMAN makes only one product . . . centrifugal pumps. The experience and know-how behind their basic designs, and modifications of them, assure you of dependable results.

So, if pumping is a problem in your plant . . . call a Pump specialist . . . a WEINMAN MAN. Write, wire or phone him . . . TODAY.



Built by Centrifugal Specialists

The WEINMAN Pump Mfg. Co.

286 Spruce Street • Columbus 7 • Ohio

Spot news

(Continued from page 108)

Heating and Ventilating Exposition, to be held in the International Amphitheatre, Chicago, January 26-30. The event will be held under the auspices of the American Society of Heating and Ventilating Engineers during their 59th annual meeting.

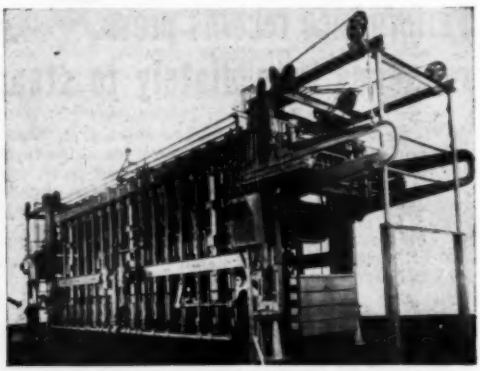
Although air conditioning for human comfort has become increasingly important, the underlying science was developed by solving some of industry's most pressing technical problems. The exhibits to be shown at the exposition are said to include a substantial proportion of industrial equipment items. Such equipment centers around air moving, heating, cooling, regulation of humidity, and the control of dusts and objectionable vapors. It includes fans and blowers, ducts and diffusers, heaters and coolers, heat exchangers and chillers, piping, conduit, valves, pumps, indicators and controllers.

A great deal of interest also will center around the displays of many manufacturers who have added new special purpose items to their list of equipment.

Still another important feature of the exposition will be a display of research activities of the American Society of Heating and Ventilating Engineers.

Goodyear Installs Huge Press For Vulcanizing Conveyer Belts

World's largest is the description used by Goodyear Tire & Rubber Co. for a conveyer belt press being installed in their flat belt production lines at Akron, Ohio. Plant

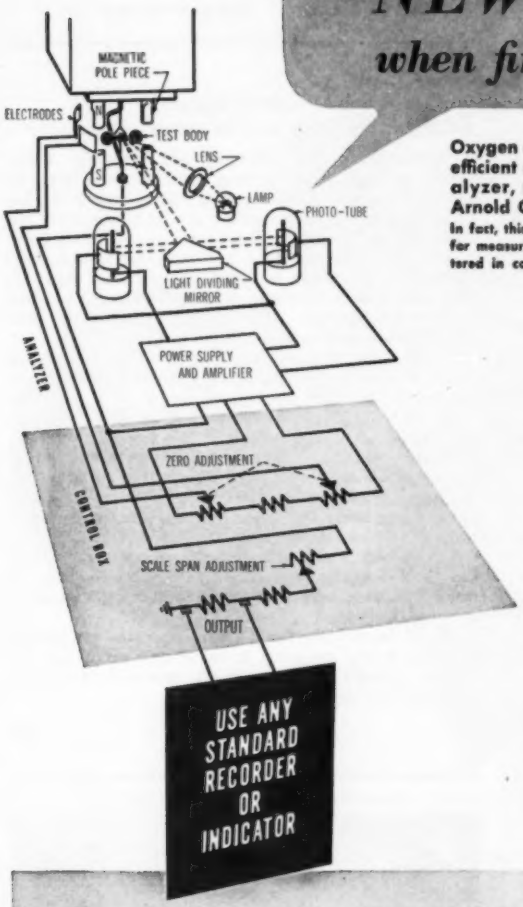


buildings had to be revised to install this huge press, since it requires two floor levels. Built by Farrell-Birmingham Co., the unit is 41 ft long by more than 80 in. wide, and weighs approximately 300 ton.

It is designed to vulcanize conveyer belts having widths up to 72 in. Equipment arranged at each end enables it to handle belts as heavy as 20 ton. Working pressure of 1500 lb, applied on each of the thirty two 18 in. diam rams, results in 275 psi on the press plates.

(Continued on page 112)

NEW SAVINGS
when firing with any fuel...



Oxygen content in flue gases has proved to be *the* criterion of efficient combustion. Need for a rugged, accurate oxygen analyzer, requiring little maintenance, has resulted... the Arnold O. Beckman Oxygen Analyzer meets this need.

In fact, this is the only oxygen analyzer that employs a direct, physical method for measuring oxygen content in gases, thereby eliminating difficulties encountered in conventional secondary methods of measurement!

The Outstanding Advantages of the Arnold O. Beckman Oxygen Analyzer stem from the fact that oxygen is extremely paramagnetic (drawn *into* a magnetic field), whereas other common gases with few exceptions are diamagnetic (repelled *out* of a magnetic field).

As indicated at left, the only moving part in this instrument is a small test body suspended in a magnetic field. Sample gas passing around this body causes it to rotate into or out of the magnetic field, depending upon the oxygen content of the gas. A beam of light, reflected from a mirror attached to the test body, permits recording the result by simple electrical circuits on *any* standard recorder or indicator. *This measurement is purely physical—not a chemical analysis—and is accomplished without recourse to filaments, catalysts, chemicals, fuels, cams, glassware, etc. which require replacement or adjustment.*

The sensitivity and accuracy of the Arnold O. Beckman Oxygen Analyzer surpass that of any other method of oxygen determination. Its simplicity eliminates practically all maintenance. It is completely automatic in operation. Variety of ranges is greater than obtainable by any other commercial analyzer, and multi-range instruments are available.

Even sampling is simpler. The unique principle of this instrument makes possible a completely new approach to sampling systems—rugged, simple, trouble-free!

Get the full story on the many ways the Model F-3 Analyzer and Sampling System can benefit your operations. Write for Data File 3C-122!

Features of the Beckman Model F-3

SELECTIVITY Highly sensitive to oxygen. Effects of gases other than oxygen are negligible.

MANY RANGES Combustion ranges include 0-5%, 0-10%, 0-15%, and are provided with a second range of 0-25%. Other ranges up to 0-100% O_2 are available. Calibration of the Model F-3 is strictly linear and scale is accurate over the entire range.

HIGH ACCURACY ± 1% of full scale for spans of 5% and greater. Accuracies within .05% O_2 on 0-5% range are available.

AIR CHECK Simple positive check of proper operation by recording the air point on the second range.

SIMPLE SAMPLING Independent of flow rate. Nothing is added to the sample. The sample may be dry or saturated. Corrosive gases will not poison the instrument. Only a small sample (3-15 cu. in./min.) is required.

LOW MAINTENANCE Completely insulated against extreme shock and vibration. No chemicals, no catalysts to replenish. No wicks, filaments, orifices, valves, etc., to clean and replace.

STANDARD RECORDERS Any standard industrial potentiometer recorder or pneumatic receiver can be used.

Arnold O. Beckman INC.

Manufacturers of Industrial and Scientific Instruments

1020 MISSION STREET

SOUTH PASADENA, CALIFORNIA

cool off the HOT SPOTS

cut heat losses ...save power, fuel and money with

B-H BLANKETS

Here is high performance insulation, effective up to 1200° F. It allows close control of operating temperatures, insuring maximum output and efficiency of equipment. Chemically stable, black rockwool is felted in large sheets between different types of metal fabrics.

Soft edges interlock and form a continuous, tight blanket of insulation. It can be covered with B-H No. 1 or B-H Powerhouse finishing and insulating cement for a permanent job... For help on any specific application or selection problem, you can depend on B-H Engineered Insulation Service.

Baldwin-Hill

Clip on signed letterhead and mail

TEAR OUT

BALDWIN-HILL COMPANY
832 Breunig Ave., Trenton 2, N.J.
Please send complete information on

- ☐ BLANKETS... Metal-reinforced, flexible, felted, black rockwool insulation
- ☐ NO. 1 INSULATING CEMENT... All-purpose, rust-inhibiting, plastic cement
- ☐ MONO-BLOCK... Rigid, felted, black rockwool block—for high and low temperature use
- ☐ POWERHOUSE CEMENT... High adhesion, black rockwool, insulating-finishing cement

Spot news

(Continued from page 110)

Conveyer Belt Weighing System Electronically Adds and Subtracts

Development of a conveyer belt weighing system capable of electronically adding, subtracting and recording the weight of material delivered to one or more points has been reported. The new system, developed jointly by the Trans-Weigh Co. and the Industrial Div. of Minneapolis-Honeywell Regulator Co., is applicable for belt-conveyed materials ranging from low-grade ore to refined sugar. It continuously weighs material being delivered and provides running measurements of tonnage as well as the total weight delivered over a period of time.

If one large belt supplies several others at different places along its length, the system can add and subtract to measure the quantity supplied to any or all of the other belts. It also can control blending of different materials on the belt, a common practice in the food industry.

In operation, the conveyer belt rides over a set of three idlers which form a wide-based trough. The force exerted on these is measured by a strain gage and the weight of the belt and other component parts is subtracted electrically. The final measurements are then fed into an electronic recorder which indicates and records instantaneous flow, and integrates total weight passing on the belt. In addition to chart records, measurements can be transmitted to remote locations.

One of the most significant advantages of the new system, according to the designers, is that it now makes cost accounting possible in cases where it previously was either impractical or impossible.

—End

IMMERSION HEATER RETIRED AFTER 25 YEARS

Charles Stenger of the Milwaukee Journal, and General Electric engineers are shown examining a G-E Calrod immersion heater just removed from its stereotype melting pot. Installed in the newspaper's shop in February, 1927, it is still operative after 25½ years of continuous service. This old style, doughnut-shaped heater was one of the first installations of its type in the country

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH R/M

In the widely diversified line of Raybestos-Manhattan packings and gaskets, you will find products specially made to solve your toughest packing problems. Let your nearby R/M distributor help you specify the packings that will assure you of long trouble-free operation. Give him a call today.

FOR R/M "TEFLON" PACKINGS, GASKETS, SHEETS, RODS, TUBES, SEE YOUR R/M DISTRIBUTOR

R/M PACKINGS

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

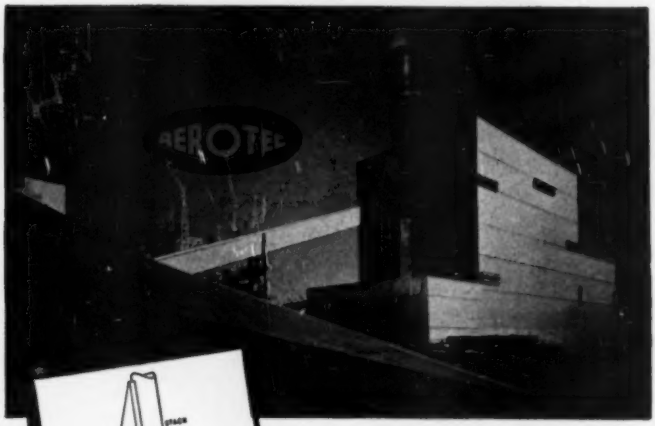
FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Peterborough, Ontario, Canada

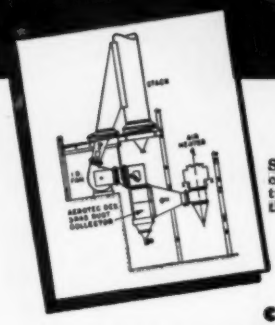
RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls

another power plant application of the

AEROTEC DUST COLLECTOR

promoting better community relations





Riverton Station
Northern Virginia Power Company

Sectional drawing shows location of AEROTEC Dust Collector between air heater and I.D. fan at this Riverton Station.

Promote your

community relations

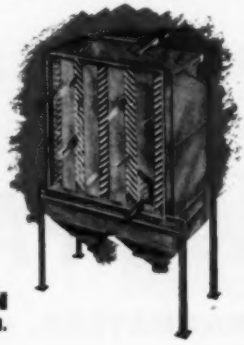
the highly efficient Aerotec way

A clean stack has proven time and again to pay valuable dividends in community good will. To gain this advantage, plus plant erection and maintenance economies, public utilities are specifying the Aerotec Design 3 RAS Dust Collector. This unit develops a higher centrifugal force through the use of multiple, small-diameter tubes, resulting in exceptionally high efficiencies on ultra-fine dusts.

Flexible and space-saving

The tubes are permanent mold aluminum and closely nested to provide lighter weight and more capacity per square foot of plan area than any collector of comparable efficiency. They are set at a 45° angle on vertical tube sheets, factory-assembled into lightweight "building block" sections that reduce installation time and permit the Aerotec Design 3 RAS to be easily tailored to fit available space.

Our field engineers specialize in solving flyash collection problems and welcome the opportunity to assist you at any time. Call or write. No obligation.



Project Engineers

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Reviews of recent books . .

Write to the publisher for books in which you are interested

Electrical Engineering

"Electrical Engineering—Theory and Practice," by W. H. Erickson and N. H. Bryant. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 523 pages, 325 diagrams and figures. Priced $6.00.

Stressing analysis and study rather than "formula substitution," this book offers a clear understanding of the basic theories of circuits, machines, and electronics. Nothing has been omitted that might be considered necessary to the continued and logical development of theory and practice. It is written in easy-to-read, easy-to-understand style with carefully thought-out explanations, examples and exercises. Covering all the fundamentals necessary for a firm grasp of the subject, it has been used at Cornell for several semesters. The three divisions of electrical engineering—circuits, machines and electronics—receive equal treatment and practical problems appear at the end of each chapter.

Meetings and exhibitions

DECEMBER

Twentieth National Exposition of Power and Mechanical Engineering, under the auspices of the American Society of Mechanical Engineers, will be held in Grand Central Palace, New York, Dec. 1-6. In conjunction, ASME will hold its annual meeting at the Hotel McAlpin, Nov. 30 to Dec. 5.

Society of Experimental Stress Analysis will hold its annual meeting and exhibition at the Hotel McAlpin, New York, Dec. 3-5.

JANUARY

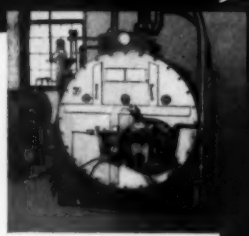
American Institute of Electrical Engineers announces its winter general meeting to be held at the Hotel Statler, New York, Jan. 19-23.

Plant Maintenance Conference, sponsored jointly by the American Society of Mechanical Engineers and the Society for the Advancement of Management, will be held at the Public Auditorium, Cleveland, Jan. 19-22. The Plant Maintenance Show will be held concurrently with the meeting.

American Society of Heating and Ventilating Engineers will hold its 59th annual meeting at the Conrad Hilton Hotel, Chicago, Jan. 26-29.

You are cordially invited to take a four-plant tour to inspect "packaged" EconoTherm Installations

. . . see how much OWNERS SAVE on fuel and labor with Dutton BOILERS



BIG RAILROAD SAVES $5,000 YEARLY WITH ECONOTHERM!

Talk first to roundhouse officials of one of America's greatest railroads*. One Dutton EconoTherm, used for roundhouse heating and hot water supply through *just the colder months each year* has made actual savings pegged at $5,000 per year! Automatically operated, it needs but a few minutes' checking daily. Former equipment required 24-hour-per-day attention.

* Name on request

STOKELY-VAN CAMP, INC., FINE FOOD PACKERS, LIKES ECONOTHERM'S FLEXIBILITY, ECONOMY

At Lakeland, Minn., stop at the sign of Stokely's Finest Foods and World Famous Van-Camp's Pork & Beans. H. H. Young, Chief Engineer, says: "The flexibility of Dutton Boilers fits well into our needs. We have a saving in boiler room labor . . . It is possible to operate with 50% less labor than previously . . . Particularly pleased with service rendered by your representatives."

ECONOTHERM UPKEEP IS ALMOST NIL AT THE CENTURY BRICK CO., MONROE, LA.

J. P. Humble, owner, can show you a gas-fired EconoTherm used around the clock, 5 or 6 days weekly, in curing sand lime brick and new, light building blocks. "In use since 1948 . . . upkeep cost practically nil . . . only shutdowns due to annual inspection or minor repairs of other machinery . . . could not make a more satisfactory purchase than a Dutton EconoTherm."

AT EVANSVILLE, INDIANA, THE WATER WORKS PLANT SUPT. SAYS "WELL PLEASED!"

And there are hundreds of others!

To get more facts first-hand, why not talk to Dutton owners near you? Contact Dutton — or ask your nearby Dutton Representative for the location of installations you can tour yourself! When you write, ask for EconoTherm Bulletin EC-100B.*

* See Yellow Pages in Phone Book.

Dutton BOILERS

CHECK FIRST with Dutton

DIVISION HAPMAN-DUTTON COMPANY

KALAMAZOO, MICHIGAN • BOILER BUILDERS SINCE 1880

FOUR TYPES — SIZES FROM 5 H.P. UP

Two model F-22 Syntron Feeders feeding coal from track hopper to conveyor belt in a Power Plant. These Feeders, in this particular installations, handle a carload of coal as fast as 20 minutes.

Fill Your Need For Heavy Tonnage Coal Handling to

Crushers, Screens, Conveyor Belts, Driers, Mullers, etc., with

SYNTRON

"Vibra-Flow"

VIBRATORY FEEDERS

Capacities of up to Hundreds of Tons Per Hour At Instantly Controllable Rates of Material Flow

Finger-tip dial control of rate of flow is standard on all models

Write Today For FREE Catalog Folder SYNTRON VIBRATORY FEEDERS

SYNTRON CO.
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News
of men and companies

SOCIETIES

American Institute of Electrical Engineers—L. F. Hickernell, chief engineer, Anaconda Wire & Cable Co., is elected a member of the board of directors succeeding W. J. Barrett, the newly elected treasurer. N. S. Hibshman, Dean of the School of Engineering, Pratt Institute, Brooklyn, N. Y. resigned as treasurer to accept a headquarters staff position as asst secretary.

ANNOUNCEMENTS

Anaconda Wire & Cable Co.—E. A. Casey, asst chief engineer, delivered a paper discussing the pros and cons of aluminum conductors as a guest speaker at the recent meeting of the Kansas Association of Municipal Utilities, Wichita, Kan.

Diesel Engine Manufacturers Association—At the recent annual meeting the following officers were elected for 1953: President, A. W. McKinney, executive v-p of The National Supply Co.; vice president, W. A. Rentschler, v-p of Baldwin-Lima-Hamilton Corp.; vice president, W. E. Butts, president of Enterprise Engine & Machinery Co.; treasurer, R. H. Morse, Jr., president of Fairbanks, Morse & Co., and as secretary and executive director, H. T. Hill of Chicago. The following men, together with the foregoing officers, will serve as directors of the association: W. S. Morris, v-p of American Locomotive Co.; C. P. Clark, president of Clark Bros. Co.; G. Lefebvre, president of The Cooper-Bessemer Corp.; G. W. Codrington, v-p and genl mgr of the Industrial Power Div. of International Harvester Co.; M. C. Davison, v-p of Ingersoll-Rand Co.; R. E. Friend, president of Nordberg Manufacturing Co.; H. Fischer, president of the Union Diesel Engine Co., and E. J. Schwanhausser, executive v-p of Worthington Corp.

Kentucky Synthetic Rubber Corp.—This company, made up of 19 non-tire rubber manufacturers and operating one of the government-owned synthetic rubber plants at Louisville, Ky., has established a small executive office at 346 Post Road East, Darien, Conn. T. Robins, Jr., president of the company is also president of Hewitt-Robins Inc. The Darien office will be headed by Dr. H. F. Palmer, v-p and formerly plant mgr in Louisville. Operating headquarters of the company will continue at the Louisville plant.

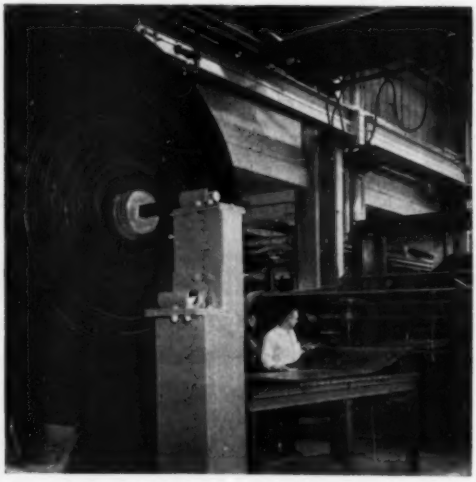
ANNIVERSARIES

Frick Co.—Celebrates its 100th anniversary this year and marks the occasion by publishing a Centennial History.

Scaife Co.—Is celebrating its 150th anniversary this year.

EXPANSIONS

Beckman Instruments, Inc.—Started construction on a 20,000 sq ft building in Mountainside, N. J., to be used as eastern sales and service offices for the parent company and as an eastern manufacturing facility for the Beckman subsidiary, Helipot Corp.



The recently dedicated $1 million addition to the Hewitt-Robins, Inc., conveyor belt plant in Buffalo, N. Y. includes this giant press which will make belts up to 72 in. wide. The new facilities increase production capacity by 41 per cent

Combustion Engineering-Superheater, Inc.—Contracted for two steel-frame buildings with a total floor space of 44,500 sq ft to be erected at the East Chicago, Ind. plant.

General Electric Co.—Contract for the construction of the multi-million dollar transformer plant in Rome, Georgia, is awarded to the George A. Fuller Co. of New York, in association with Van Winkle & Co. of Atlanta, Georgia.

Goodyear Tire & Rubber Co.—Announces plans for a $1½ million expansion program for its chemical division. The project is described as an addition to existing Akron facilities for the production of Chemigum synthetic rubber.

Marlow Pumps—Puts into operation a complete branch factory of 16,000 sq ft in De Queen, Ark. In addition to manufacturing and assembling pumps for the irrigation, petroleum, and contracting industries, the new factory will also carry a complete inventory of all Marlow pumps as well as replacement parts. Sales and engineering staffs have been enlarged and will use the new plant as a regional headquarters.

APPOINTMENTS

Goodyear Atomic Corp.—Organization of key personnel for the operation of the government's gigantic atomic energy plant, now under construction near Portsmouth, Ohio, is well under way. Transferred from other posts in the Goodyear organization and assigned to duties in the staff engineering and maintenance div, headed by W. A. Brown, are: H. F. Porter, Jr., head of the electrical and instrument div; R. J. Nance, supt of shops maintenance; R. M. Rutherford, head of utilities and utilities maintenance; T. W. Leary, supt of process maintenance; A. J. Brust, supt of planning and scheduling; N. H. Hurt, Jr., supt of staff engineering.

H. F. Porter, Jr.

R. J. Nance

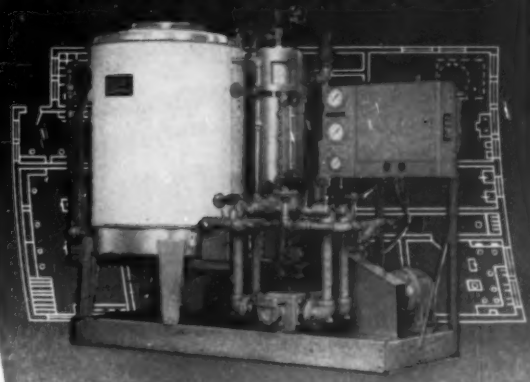
NEW REPRESENTATIVES

Conoflow Corp.—Appoints George Chipley, Milwaukee, as representatives in the state of Wisconsin.

The Syntron Cleveland Sales Co.—Syntron Co. representatives opens a new store at 2919 Carnegie Avenue, Cleveland, Ohio. The Syntron St. Louis Sales Co. announces opening of a new store at 4431 Manchester Avenue, St. Louis, Missouri.

(Continued on page 118)

MORE STEAM
Faster and at Less Cost



SPECIFY *Clayton*
FORCED RECIRCULATION
STEAM GENERATORS

Plan your steam plant for long range economy and realize immediate savings on installation and operating costs.

The Clayton *Forced Recirculation* Steam Generator...in sizes from 15 to 100 h.p., and equipped to burn gas or oil, or both...is a compact, self-contained steam plant ready to install and operate as it is delivered. No accessories to buy. No stack, bricking or foundations to install. Move into place; connect fuel and water lines, electricity and vent, and the Clayton generator is ready to operate. Occupies 30% to 70% less space than conventional boilers of same capacity.

Within 5 minutes from a cold start, the Clayton generator attains full operating pressure. Any fluctuating load demand within its rated capacity is instantly and automatically met. No standby losses. High thermal efficiency cuts fuel costs in half, or better. On gas fired units, new electronic safety control proves the flame pilot; automatically shuts down plant on ignition failure or loss of fire. Clayton generators are built to conform to the A.S.M.E. Boiler Code, and are Hartford inspected. Send the coupon for complete catalog.

The coupon below brings a convincing demonstration to your desk.

STEAM PLANT OPERATORS *Mail this coupon*

CLAYTON MANUFACTURING COMPANY IP-12
Box 550, EL MONTE, CALIFORNIA

Send name of nearest distributor and arrange desk demonstration of Clayton *Forced Recirculation* principle. Send catalog.

NAME_____

FIRM_____

ADDRESS_____

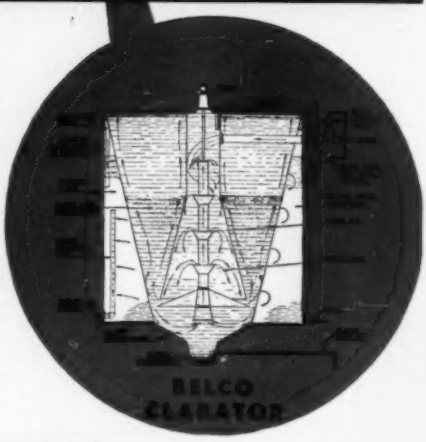
CITY_____ STATE_____

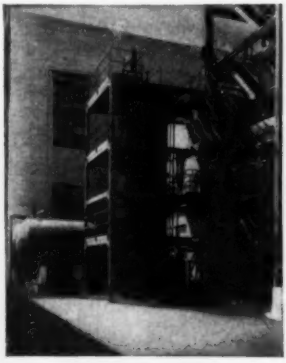
Animated flow chart shows how *Forced Recirculation* principle cuts steam costs.

PROCESSES FOR REMOVAL OF WATER IMPURITIES

BELCO Clarator produces multiple savings for a Utility

The Clarator has multiple uses — clarification, stabilization, neutralization, chlorination, purification, alkalinity reduction, softening, silica removal, iron removal, controlled conditioning. The type and quantities of the chemicals used determine the final quality of the treated liquid effluent. Complete description and illustrations in Bulletin 108. Write for your copy.





Hot Process Softeners

Belco hot process softener settling tank and chemical feed equipment for high pressure boilers in southwest utility power house. The superior results of this type equipment have been proven in numerous installations.

Ask the Belco man!

★ We invite your consultation regarding all water conditioning requirements. Get acquainted with our organization for authoritative assistance and close cooperation. Write for late descriptive bulletins.

Belco

Belco Industrial Equipment Division, Inc.
PATERSON 3, NEW JERSEY

News

of men and companies

(Continued from page 117)

The Hammel-Dahl Co.—Announces appointment of James E. Dyer of Tulsa and Oklahoma City, Okla. as additional sales and service representatives.

The Terry Steam Turbine Co.—The Hesler Co., which has represented Terry in Kansas City, Mo., since 1946, recently opened an office at 1110 Brentwood Blvd., St. Louis Mo.

Warren Steam Pump Company, Inc.—Announces appointment of J. F. Murray Co., 100 East Pleasant St., as their representatives on industrial sales for the Baltimore area.

SALES OFFICES

The American Brass Co.—Announces opening of a district sales office in Cedar Rapids, Iowa. J. N. Allen, formerly of the Chicago sales staff, is appointed district sales mgr.

Builders-Providence, Inc.—BIF Industries has established a service center at 913 Artic Bldg., in Seattle, Wash. with L. W. Armstrong in charge.

Gould-National Batteries, Inc.—Moves its northeastern area service and repair center from North Bergen, N. J., to larger quarters at 309 51st Street, West New York, N. J.

Reliance Electric & Engineering Co.—Removal of the Newark, N. J., sales office into newer and larger quarters at 535 High St. is announced.

APPOINTMENTS

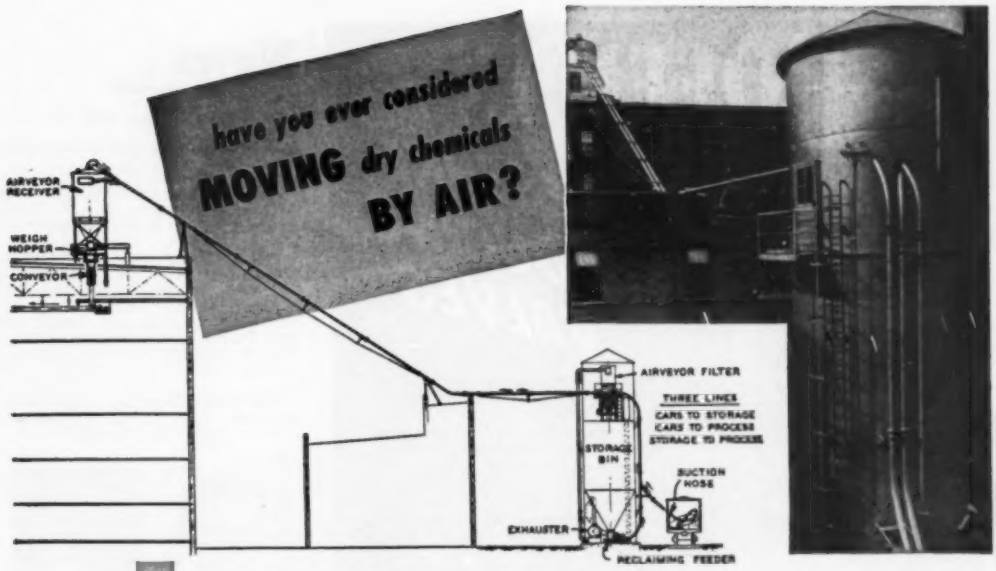
Allis-Chalmers Manufacturing Co.—F. X. Carney, W. G. Meier and F. A. Renneisen are newly assigned as asst engineers to the power dept. Carney is named to the steam turbine section, and Meier and Renneisen to the electronics section.

Norton Co.—W. H. Henson is appointed special sales representative for the refractories div. At the same time, C. W. Henson was reassigned to the

W. H. Henson **H. T. Pierpont**

refractories sales dept. H. T. Pierpont, Jr., sales mgr. refractories div, is elected vice president of the Special Refractories Association.

(Continued on page 120)



it's cheaper—safer—more efficient

The AIRVEYOR®

Moving air has great carrying ability. When it's controlled, air supports and transports dry granular or pulverized materials at high speed to any predetermined point.

For example—a leading soap manufacturer, using the Airveyor, has found the savings quickly pay for this better method of handling light soda ash. Unloading, conveying to, and reclaiming from storage for delivery to process in the plant, is accomplished quickly and with a minimum of labor. The Airveyor requires the attention of only one man. Important from the safety angle is the fact that dusting has been eliminated. Few moving parts assure reduced maintenance.

Note the compact, simple layout of the system illustrated . . . the storage bin located alongside of the railroad track, with the Airveyor filter directly above, and the exhauster below the bin, all within the same structure.

The Airveyor in this plant unloads from cars to storage and reclaims from storage for delivery to process. The system is so arranged that material can also be conveyed direct from cars to process if desired. Longest conveying distance—200 feet.

Why not investigate the possibilities of this flexible system of handling chemicals in your plant? Airveyors handle a wide range of dry pulverized and granular ingredients—safely, cleanly, economically, speedily and efficiently. Without obligation, a Fuller engineer will analyze your present conveying system and show you how the Airveyor can help in your operations.

Fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS—COMPRESSORS AND VACUUM PUMPS—FEEDERS, AND ASSOCIATED EQUIPMENT

FULLER COMPANY
Catasauqua, Pennsylvania
Chicago 3—120 So. LaSalle St.
San Francisco 4—420 Chancery Bldg.

A-128

HOFFMAN TRAPS VALVES PUMPS

HOFFMAN SPECIALTY MFG. CORP., 1001 YORK ST. INDIANAPOLIS 7, IND.
Makers of Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems.
Sold by leading wholesalers of Heating and Plumbing Equipment.

News
of men and companies

(Continued from page 118)

Beckman Instruments, Inc.—Announces appointment of J. F. Bishop as asst genl mgr of the instrument div.

Detroit Stoker Co.—Announces the appointment of M. H. Snodgrass as v-p, sales. He was formerly sales mgr of the New York district. Also names G. S. Hodges sales mgr, Detroit district. Both men will headquarter in the general sales and engineering office in Detroit, Mich.

The Fluor Corporation, Ltd.—Appointment of E. Dewey as supervisor of sales promotion is announced.

E. Dewey E. Schmidt

Refinite Corp.—The appointment of E. Schmidt to the position of chief engineer is announced.

The B. F. Goodrich Co.—R. D. Hager becomes genl mgr of industrial products manufacturing. L. D. Tidball, former production supt of the industrial products div, is made genl supt, replacing Hager. W. L. Smith is appointed technical director of industrial products manufacturing with responsibilities to integrate the technical activities of all industrial products operations. E. F. Miller succeeds Smith as technical supt of the Akron industrial products div. A. E. Williams is named technical mgr of hose manufacture.

The International Nickel Company, Inc.—Names R. L. Lloyd genl mgr of advertising and R. A. Wheeler asst genl mgr of advertising. Also appoints M. J. Phillips asst to the genl mgr of advertising and H. S. Lewis and A. P. More asst mgrs of advertising.

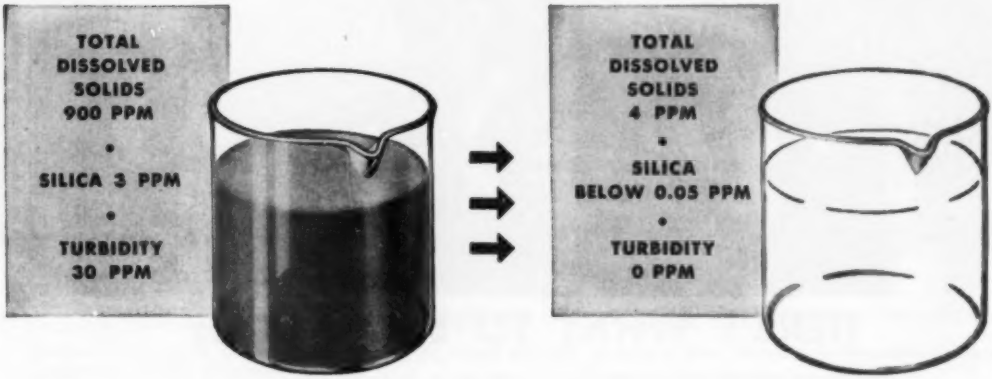
Quaker Rubber Corp.—Appoints F. P. Murken manager, Industrial Hose Div.

Westinghouse Electric Corp.—O. L. Taylor is named mgr of engineering for the Bryant Electric Co., a wholly owned subsidiary. Taylor will succeed E. E. Forstrom, who retires early next year.

Worthington Corp.—I. August, formerly superintendent of the Denver, Colorado, plant is appointed asst to the works mgr of the Holyoke, Mass. plant. August is succeeded by M. Berman.

—End

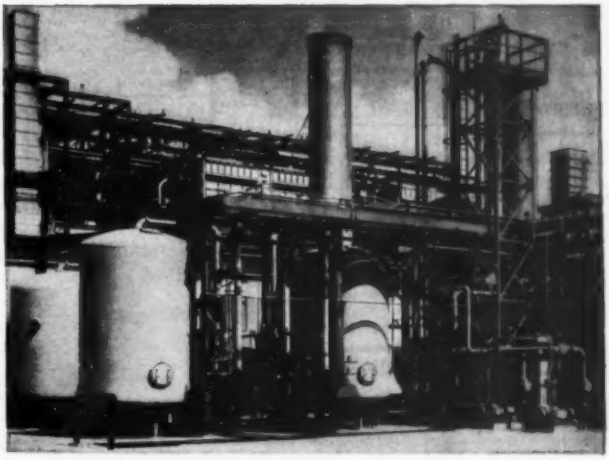
A Graver Demineralizer makes the difference



This Graver demineralizer installation had to tackle a *doubly* tough water purification problem . . . extreme hardness plus turbidity. And 600 gpm has to be treated.

But the Graver plant is combining demineralizing plus filtering of this large demand with complete success. In addition, a Graver Vacuum Deaerator following the Demineralizer completely eliminates CO_2 and reduces the oxygen below 0.2 ppm. As a result, the effluent is ideally suited for the high pressure boilers served by the Graver installation.

For similar success in solving *your* water treatment problem, investigate Graver's proven modern equipment designs based on over 40 years of specialized experience and pioneering in every water treating process. Your request for recommendations will involve no obligation.



Double train, two-bed Graver Demineralizer installation at a large southwestern chemical plant, treating 864,000 gallons per day of raw water for 450,000 pounds per hour, 1250 psig boilers.

GRAVER WATER CONDITIONING CO. GRAVER

Division of Graver Tank & Mfg. Co., Inc.

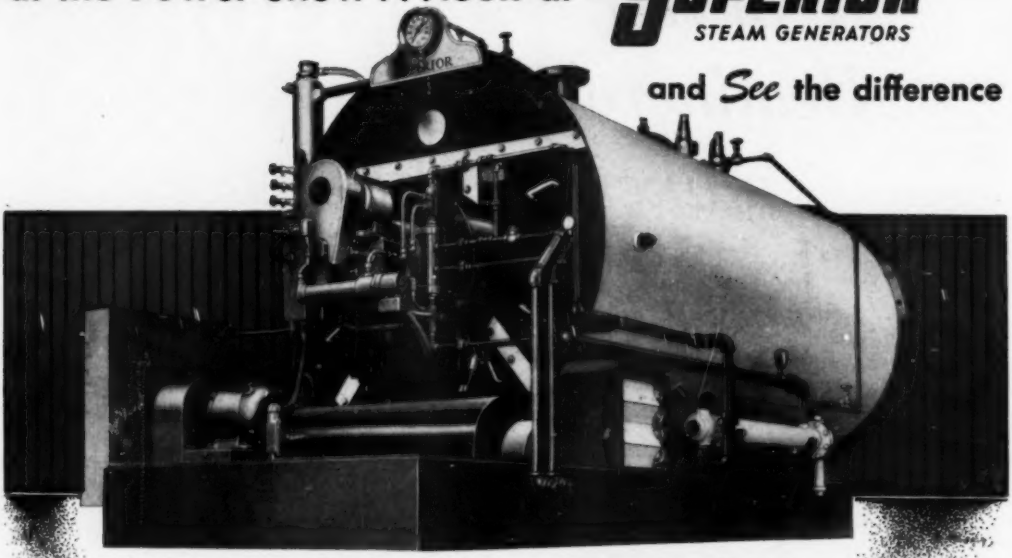
DEPT. IP-D, 216 WEST 14TH STREET, NEW YORK 11, N. Y.

In Canada: The Bird-Archer Co., Ltd.; Cobourg, Ontario
In Mexico: Proveedores Tecnicos, S.A.; Puebla 259, Mexico 7, D. F.

GW 470

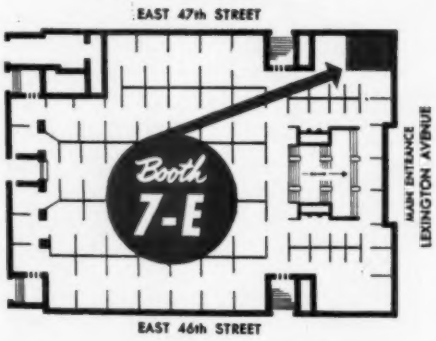
at the Power Show . . . look at SUPERIOR STEAM GENERATORS

and *See* the difference



HERE'S WHAT TO LOOK FOR:

POWER SHOW
DEC. 1st through DEC. 6th



GRAND CENTRAL PALACE
NEW YORK

Look . . . at Superior's 4-pass fire-tube design . . . ample heating surfaces with a minimum of 5 sq. ft. per b.h.p.

Look . . . at Superior's built-in multiple induced-draft fans . . . drawing evenly across the entire tube area, and eliminating the need for an expensive chimney.

Look . . . at Superior's Rotary Burner with its own fan supplying primary air . . . fully automatic with oil or gas, or both . . . change from either fuel to the other quickly, without dismantling equipment or interrupting steam supply.

Look . . . at Superior's safety features . . . induced draft which prevents the escape of combustion gases into the boiler room . . . fool-proof combustion gas pressure-relief port . . . constant gas pilot throughout gas firing periods . . . dual purging of all gas passages, both before and after firing.

Look . . . at the overall picture . . . a complete packaged steam plant. One purchase shipped completely assembled after factory test to assure dependable operation at a guaranteed thermal efficiency of more than 80%.

Look . . . at Superior's catalog for the complete story. If you're not going to the show, write for Catalog 402.

for performance you can **BANK** *on*

SUPERIOR STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

3 *special departments featured monthly to give you FREE bulletins, catalogs and product data screened for your personal interest in*

ENGINEERED PLANT SERVICES

1. NEW EQUIPMENT

Begins on page 10

Contains highlights of new products by leading manufacturers, briefed and illustrated for your easy reference. Complete data on each of these products are available **free.**

2. NEW BULLETINS

Begins on page 140

Includes descriptions of only those bulletins and catalogs that are really **new** and of **direct value** to you — saves your reading time, yet gives you full service. All bulletins sent to you **free** on request.

3. READERS GUIDE TO ADVERTISED PRODUCTS

Begins on page 125

Designed to catalog advertised products for your convenience in finding the ads which are of special interest to you at this time. Also lists those important bulletins, catalogs and working data offered **free** in the advertisements.

REQUEST CARD FOR LITERATURE OR MORE INFORMATION—Dec., 1952

To: INDUSTRY AND POWER, St. Joseph, Mich. Please have forwarded to me, at no obligation, the literature I've indicated by the following key numbers:

New Equipment begins Page 10	*New Bulletins begins Page 140*	*Advertised Products begins Page 125*
No.'s	No.'s	No.'s

Your Name _____ Title _____

Your Company _____

Co. Address (St. & No.) _____

City _____ State _____

Inquiries for items listed in this issue not serviced beyond April 1, 1953

FIRST CLASS
PERMIT No. 19
(Sec. 34.9, P.L. & R.)
ST. JOSEPH, MICH.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

3¢—POSTAGE WILL BE PAID BY

INDUSTRY AND POWER

420 MAIN STREET

ST. JOSEPH, MICH

3 *special departments featured monthly to give you FREE bulletins, catalogs and product data screened for your personal interest in*

ENGINEERED PLANT SERVICES

1. NEW EQUIPMENT

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Your Name _____ **Title** _____

Your Company _____

Co. Address (St. & No.) _____

City _____ **State** _____

Inquiries for items listed in this issue not serviced beyond April 1, 1953

Readers' guide to advertised products

This department is both a product index for advertising and a keyed listing for advertised literature. Refer to advertisement on page indicated and contact advertiser directly—or list paragraph key numbers on reader service card (page 123) to get data you want

AIR & DUST FILTERS & COLLECTORS

Cupola Collectors **500**
Bull 440 describes cupola collectors for washing cut foundry fly-ash and fumes. Claude B. Schneible Co. p 34.

Dust Collectors
Adv. page 114 contains information on Aerotec design 3 RAS dust collector. The Thermix Corp.

ANTI-CORROSIVE & PROTECTIVE COATINGS

Rust Preventive **501**
Adv. p 65 contains coupon for complete information on Rust-Oleum sealing compound. Rust-Oleum Corp.

BOILERS & BOILER ACCESSORIES

Baffles **502**
Bull BW44 contains information on Enco streamline baffles. The Engineer Co. p 23.

Steam Generating Units
Adv. p 24, 25 contain information on Riley steam generating units. Riley Stoker Corp.

Boilers
Adv. p 128 contains information on Kewanee steel boilers. Kewanee Boiler Corp.

Vertical Unit Boilers
Adv. p 33 contains information on C-E vertical unit boilers. Combustion Engineering-Superheater, Inc.

Steam Generators **503**
Information available on Wickes steam generators. The Wickes Boiler Co. p 157.

BUILDING MATERIALS & MAINTENANCE

Thread Sealer **504**
Free sample of Key graphite paste for oil, gasoline, high-pressure steam piping. Key Company. p 155.

Floor Patch **505**
Send coupon on page 154 for complete details of trial order plan and Handbook of Building Maintenance. Flexrock Co.

Metal Grating **506**
Free booklet "Instructions for Laying Klemp Hexsteel and Floorsteel". Klemp Metal Grating Corp. p 142.

Iron Cement **507**
Free Repair Handbook describes Smooth-On repairs. Smooth-On Mfg. Co. p 136.

Steel Grating **508**
Bull 2365 contains data on electroforged steel grating. Blaw-Knox Div., Blaw-Knox Co. p 129.

COAL, ASH & BULK HANDLING

Electric Vibrators **509**
Free catalog folder available on Syntron electric vibrators. Syntron Co. p 135.

Vibratory Feeders **510**
Catalog contains data on Syntron vibratory feeders. Syntron Co. p 116.

Coal & Ash Handling **511**
Folder available on typical Beaumont installations. Beaumont Birch Co. p 130.

Airveyor
Adv. p 119 contains information on the Fuller Airveyor pneumatic conveying system. Fuller Co.

COMPRESSORS

Motor-Driven Compressors **512**
Bull 118 contains data on Clark balanced-opposed, motor-driven air compressors. Clark Bros. Co., Inc. p 4.

Air Compressors **513**
Catalog 5110-A contains the complete Schramm story on stationary air compressors. Schramm, Inc. p 149.

CONTROLS, REGULATORS & INSTRUMENTS

Tank Gage **514**
Details available on Liquidometer tank gage. The Liquidometer Corp. p 127.

Combustion Control **515**
Case histories and booklet on "Boiler Plant Instrumentation." Bull R-8 describes Hays combustion control system. The Hays Corp. p 64.

Indicators and Recorders **516**
Free booklet contains data on Ranarex indicators and recorders. The Permutit Co. p 135.

Testing Instruments **517**
Bull GEC-901 describes hook-on voltmeter. Other instruments mentioned also. General Electric Co. p 58.

(Continued on page 126)

PRODUCT INDEX

Air & Dust Filters & Collectors	125	Lubricants, Lubrication, Oil Filters & Purifiers	128
Anti-Corrosive & Protective Coatings	125	Materials of Construction	130
Boilers & Boiler Accessories	125	Mechanical Power Transmission	130
Building Materials & Maintenance	125	Packaged Steam Generators	130
Coal, Ash & Bulk Handling	125	Packing & Gaskets	130
Compressors	125	Pipe, Tubing & Hose	132
Controls, Regulators & Instruments	125	Pumps	132
Electrical Distribution	126	Refractory Concretes	132
Electrical Heating Units	126	Soot Blowers & Tube Cleaners	132
Engines	126	Steam Specialties	134
Fans & Blowers	126	Thermal Insulation	134
Filters, Strainers & Purifiers	126	Valves	134
Fuels & Firing Equipment	128	Water Treatment	137
Heat Exchanger Equipment	128	Miscellaneous	137

ROTOJET Junior
TUBE CLEANERS
Powerful, Light-weight
for SMALL TUBES
Rotojet Junior Tube Cleaners are powerful, yet light in weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Simple design and precision construction assure long service, efficient use of power, and freedom from trouble. Clean tubes from .495" to 2.062" I.D.
Bulletin J-410 shows Rotojet Junior motors and accessories to help you do a faster, more thorough tube cleaning job. Send for your copy.

S32 ROTOJET Junior Air-driven Motor, cone cutter, universal joint

C439 ROTOJET Junior Air-driven Motor, universal joint, drill head

C324 ROTOJET Junior Water-driven Motor, univ. joint, pivot head.

C434 ROTOJET Junior Air-driven Motor, flexible coupling, expanding brush.

ELLIOTT COMPANY-ROTO DIVISION
156 Sussex Avenue Newark 1, N. J.

Readers' guide to advertised products

(Continued from page 125)

Regulators **518**
Bull 100 gives full details on wide line of automatic regulating valves. Spence Engineering Co., Inc. p 60.

Temperature Regulators
Adv. p 117 contains data on Hoffman pressure reducing valves and temperature regulators. Hoffman Specialty Mfg. Corp.

All Metal Thermometers **519**
Literature available on Weston all-metal thermometers. Weston Electrical Instruments Corp. p 137.

Oxygen Analyzer **520**
Data File 3C-122 contains full story on many ways the Model F-3 analyzer and sampling system can benefit your operations. Arnold O. Beckman Inc. p 111.

ELECTRICAL DISTRIBUTION

Unit Substations **521**
Catalog Section 9000 contains complete data on I-T-E unit substations. I-T-E Circuit Breaker Co. p 18, 19.

Circuit Breakers **522**
Bull 1410 contains complete data on Heinemann motor controllers and circuit breakers. Heinemann Electric Co. p 154.

HOW TO REQUEST FREE LITERATURE

Insert "key" numbers on return post card found on page 123. For quick reference to free literature offered by advertisers in this issue, refer to listing on page 138. Our Reader's Service Department will handle your request promptly.

ELECTRICAL HEATING UNITS

"Packaged" Electric Heat **523**
Booklet "100 Ways to Apply Electric Heat" contains complete details on application of Chromalox heaters. Edwin L. Wiegand Co. p 61.

ENGINES

Engines
Adv. p 41 contains data on Worthington dual fuel engines. Worthington Corp., Engine Div.

FANS & BLOWERS

Fans & Blowers **524**
Coupon in adv. p 2 will bring information on Hartzell fans and blowers. Hartzell Propeller Fan Co.

FILTERS, STRAINERS & PURIFIERS

Auto-Klean Strainers **574**
Coupon on p 156 brings you data on Cuno Auto-Klean strainers. Cuno Engineering Corp.

(Continued on page 128)

RODA — High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

CENDECO — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK — The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE — Roda and Stonega from Wise County, Va.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL — High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER — Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO — High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

ANTHRACITE

Hazel Brook—*Premium Lehigh*
Raven Run—*Premium Mahanoy*
Cross Creek—*First Grade Lehigh*

Our engineering service, available upon application, and long and varied experience is your assurance of the Right Coal — Property Applied.

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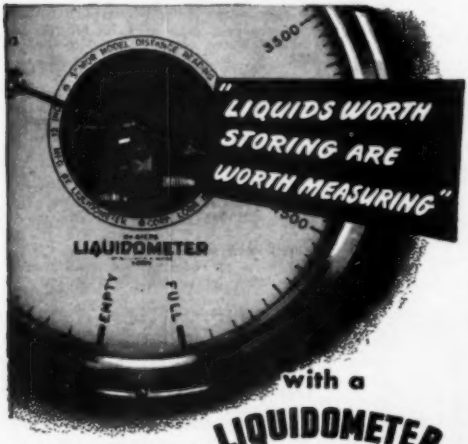

with a **LIQUIDOMETER** *Tank Gauge*

- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

WRITE FOR COMPLETE DETAILS

THE LIQUIDOMETER CORP.
36-32 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

HOW TO GET BETTER PUMP PERFORMANCE

Worn, leaky pump valves are the cause of frequent repairs. Replace them with Sims Pump Valves — you'll get guaranteed better performance.

These four features combine to give you longer service with Sims valves:

1. Exclusive double shock-absorber stem heads eliminate stem breakage.
2. Long guide gives even lift — reduces wear. Spring is protected against jamming.
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4. Inclined ribs reduce turbulence. Low resistance prevents vapor binding — allows increased speed that gives you greater pump capacity.

WRITE FOR NEW CATALOG

Write for new catalog showing how Sims valves fit your pump and give better pump performance.

SIMS PUMP VALVE CO., INC.

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Factory and Boiler House
NU-TONE CHIMES CORPORATION
Cincinnati, Ohio
J. & E. WARM CO.
Builders and Contractors
4 Kewanee Type "C" Boilers installed by
PECK-HANNAFORD & BRIGGS CO.

Modern Factories Need the *EXTRA STEAMABILITY* of

KEWANEE

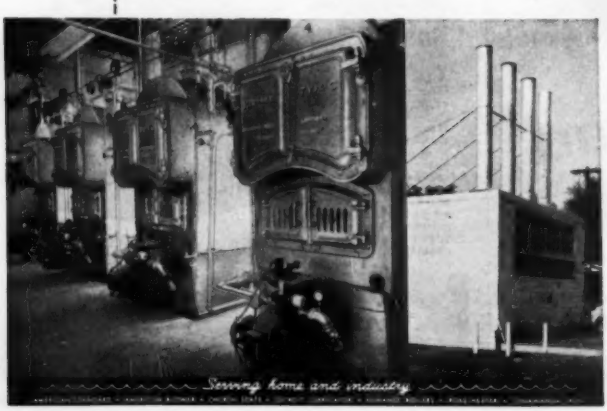
STEEL BOILERS

The design of modern factory buildings is undergoing a radical change . . . spreading out rather than going up . . . with greatly enlarged roof areas, many skylights and the walls largely windows.

While this modern construction provides better light and a smoother flow of materials through production lines it steps up steam requirements.

With 4 large Kewanees . . . total capacity of 25,000 square feet steam (5 million Btu) . . . the new plant of Nu-Tone Chimes can be sure of plenty of heat all over the building. And the ability of Kewanee Boilers to carry overloads of 50% and more, with high efficiency, provides an ample reserve to handle later plant expansion without additional boiler equipment.

KEWANEE-ROSS CORPORATION
Division of American Radiator & Standard Sanitary Corporation
KEWANEE, ILLINOIS



Readers' guide to advertised products

(Continued from page 126)

FUELS & FIRING EQUIPMENT

Burners **525**
Literature available on Series Y and YC combination gas and oil burners. John Zink Co. p 107.

RotoGrate Stokers **526**
Bulletin contains data on Detroit RotoGrate stokers. Detroit Stoker Co. p 43.

Stokers **527**
Coupon offers full information on Taylor stokers. American Engineering Co. p 55.

Coal
See adv. p 12, 13 for information on bituminous coal. Bituminous Coal Institute.

Coal
Adv. p 45 contains data on Southern's engineered industrial coal. Southern Coal Co., Inc.

Coal
Adv. p 127 contains data on this product. General Coal Co.

HEAT EXCHANGER EQUIPMENT

Instantaneous Water Heaters **528**
Engineering data available on instantaneous water heaters. Pick Mfg. Co. p. 129.

Condensers & Auxiliaries **529**
Bull 410 describes condensers; Cat 1462 on steam jet ejectors; Catalogs G-340 and G-1050 on Wheeler-Economy pumps. C. H. Wheeler of Philadelphia. p 8, 9.

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

Force Feed Lubrication
Adv. p 151 contains data on Manzel force feed lubrication. Manzel, Inc.

Non-Fluid Oil **530**
Instructive bulletin and free, testing sample of Non-Fluid Oil. New York & New Jersey Lubricant Co. p 130.

Lubrication Systems
Specialists in lubrication, filtration, oil storage, metering for industry. Bowser, Inc. p 50.

Rubilene Oil
Adv. p 46, 47 contains information on Sinclair Rubilene oil. Sinclair Refining Co.

Colloidal Graphite **531**
Bull 426-17M, "Use of Colloidal Graphite for Metalworking Operations". Acheson Colloids Co. p 53.

Lubricant
Adv. p 57 describes Standard HD oil. Standard Oil Co. (Indiana)

(Continued on page 130)

EVERY STEP A SAFE STEP WITH BLAW-KNOX GRATING

Everyone walks safely, confidently on Blaw-Knox Electroforged Steel Grating . . . the one-piece panels stay rigid and strong—without shimmy or shake—because there are no parts to work loose. Twisted cross bars provide sure footing under the most adverse conditions. For complete information, write for Bulletin 2365.

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Industry's first choice for
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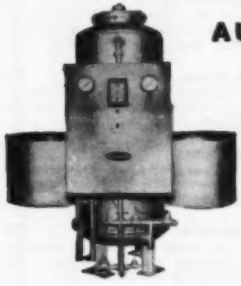
BLAW-KNOX ELECTROFORGED STEEL GRATING

HIGH PURITY WATER
For Boiler Feed, Process & Other Needs

COMPLETELY AUTOMATICALLY*



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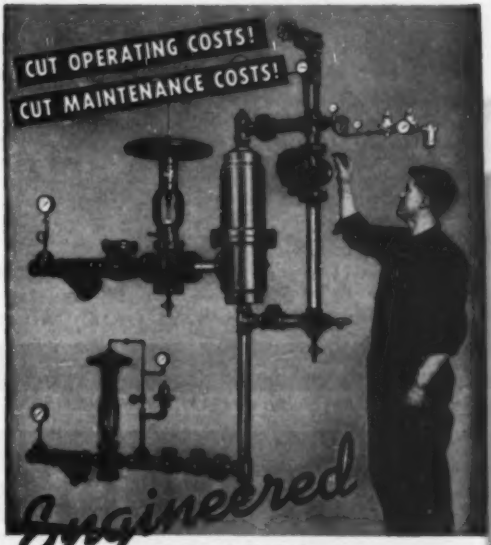
*The new Penfield Mono-Column Demineralizer pictured above performs all its operating functions completely automatically — even recuts in effluent when proper preset purity is reached after automatic regeneration. Write for full information on units of any desired capacity up to 10,000 gph.

PENFIELD MANUFACTURING CO., INC.
19 High School Ave., Meriden, Conn.
FILTERS · SOFTENERS · DEGASIFIERS · DEMINERALIZERS

Penfield "Planned Purity" PAYS!

THE SURE WAY TO CUT HOT WATER *Costs!*

Pick INSTANTANEOUS WATER HEATERS



TO PROVIDE ANY VOLUME OF WATER AT THE TEMPERATURE REQUIRED!

Here's the money-saving answer to hot water required for industrial needs. PICK Heaters provide hot water *instantly* — by steam injection. They're entirely automatic to provide and accurately maintain temperatures up to 180° F. The exclusive Pressurizer Piston stabilizes injection pressure — eliminates pipe hammering and shaking. Available in seven sizes with rated capacities of 10 to 200 gallons per minute. Greater volumes can be obtained by multiple installations. Installation is simple, requiring only ordinary pipe connections.

NO STORAGE TANKS NEEDED
Compact design permits installation in corners, on walls or overhead.

EASILY CLEANED
No coils. Can be cleaned in a matter of minutes — without dismantling.

Proved
BY PERFORMANCE IN
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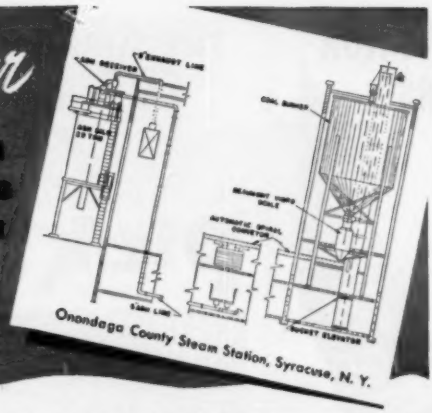
WEST BEND, WISCONSIN, U.S.A.

Another
COAL and ASH HANDLING INSTALLATION by BEAUMONT



Here's one of the many efficient coal and ash handling installations — designed, manufactured, installed by *Beaumont*. The above system is located at Onondaga County Steam Station, Syracuse, New York. This plant saved both time and expense — through one-contract economy . . . But you're right! It's up to us to convince you of the advantages in a *Beaumont* installation: So let us send you our folder of typical installations. Write to:

Beaumont BIRCH COMPANY
1509 RACE STREET, PHILADELPHIA 2, PA.

DESIGNERS—MANUFACTURERS—ERECTORS BULK MATERIAL HANDLING SYSTEMS

Represented in Canada by: **COMBUSTION ENGINEERING CO., LTD., Montreal, Que.**

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TRADE MARK REGISTERED

Provides Positive Bearing Protection

Dripping, leaking oil cuts production. It won't stay in bearings, so does not lubricate dependably and needs frequent application. Bearings run hot and often burn out.

What to do about it? Change to NON-FLUID OIL and watch your production go up . . . lubricant and application costs go down. NON-FLUID OIL stays where applied, keeps bearings cool, and outlasts ordinary oils and greases because it lubricates dependably until entirely used up. Send today for instructive bulletin and free, testing sample of NON-FLUID OIL.

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NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

Readers' guide to advertised products

(Continued from page 128)

Adhesive Pressure Grease
Adv. p 103 contains data on Sun 897 adhesive pressure grease. Sun Oil Co.

MATERIALS OF CONSTRUCTION

Nickel Alloy
Adv. p 62 contains information on "S" Monel. The International Nickel Co., Inc.

MECHANICAL POWER TRANSMISSION

Flexible Couplings **532**
Catalog and quick-finding selector charts on Lovejoy flexible couplings. Lovejoy Flexible Coupling Co. p 135.

Grommet V-Belts
Adv. pages 35-38 discuss Goodrich grommet belts. The B. F. Goodrich Co., Industrial Products Div.

Conveyor Belts
Consult the Goodyear Technical Man for your needs in conveyer belts. Goodyear Tire & Rubber Co. p 3.

Roller Bearings
Adv. p 52 contains information on Hyatt roller bearings. Hyatt Bearings Div., General Motors Corp.

Steel Collars **533**
Literature describes solid steel collars. Hallowell Power Transmission Div., Standard Pressed Steel Co. p 155.

PACKAGED STEAM GENERATORS

Packaged Boilers **534**
Econotherm Bull EC-100C contains data on Dutton packaged boilers. Hapman-Dutton Co., Dutton Boiler Div. p 118.

Steam Generators **535**
Coupon p 120 offers catalog on Clayton forced recirculation steam generators. Clayton Mfg. Co.

Packaged Steam Boilers **536**
Catalog contains full story on Cleaver-Brooks self-contained steam boilers. Cleaver-Brooks Co. p 59.

Packaged Boilers **537**
Catalog gives facts on Powermaster packaged boiler with Voriflow combustion. Orr & Sembower, Inc. p 100.

Steam Generator **538**
Adv. p 122 offers Cat 402 on complete story of Superior steam generator. Superior Combustion Industries, Inc.

PACKING AND GASKETS

Packings **539**
Full details available on complete line of "John Crane" packings. Crane Packing Co. p 144.

Mechanical Seal **540**
Bull 427 IP contains detail on mechanical sealing. Durametallic Corp. p 133.

Packings
Adv. p 113 contains data on R/M pack-

(Continued on page 132)

Making Warm Friendships on Hot Jobs

WATER JACKETED APCO PUMP

Developed especially for the efficient handling of high temperature and highly volatile liquids. Delivers outstanding performance. Unbeatable on high head, small capacity duties.

PUMPS by Aurora

For Every Purpose

APCO Turbine-Type PUMPS

—ideal for "100!" duties where small capacities and high heads predominate. Get acquainted.

AURORA CENTRIFUGAL PUMPS

are available in many types and sizes—all noted for their streamline coordination between impellers and shells.

We Invite Your Special Pump Problems

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AURORA Always PUMPS

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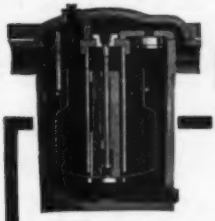


ILLINOIS STEAM TRAP

Simple—has only two moving parts

Valve Stem Travels Independent of Bucket—no other trap has this feature.

Instantaneous Valve Action—either wide open or tight shut—will not dribble on partial closing of valve under slow condensation rates.

Wire Drawing Impossible—valve has snap action.

Simple—moving parts are valve and bucket.

Cannot Air Bind—vents air continuously without loss of steam.

Cannot Blow Steam—always water sealed.

Surface Discharge—flushes out all grease and sludge.

Valve Seat—of special alloy, fully guaranteed.

Inspection Easy—without disturbing piping.

Works Equally Well on All Fluids—compressed air lines, air separators, air aftercoolers.

Write for Bulletin 35

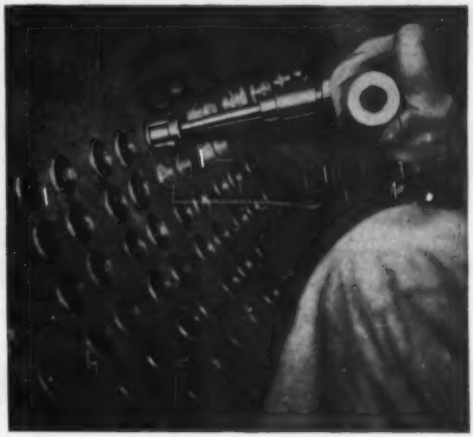
Consult us on your requirements

ILLINOIS ENGINEERING COMPANY

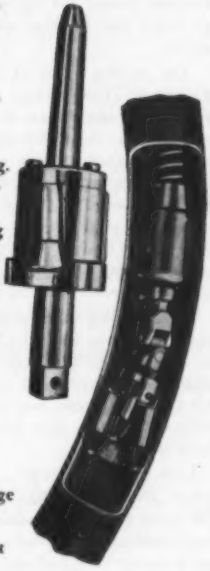
RACINE AVENUE AT 21ST STREET • CHICAGO 8

WILSONIZE

- *to get better tube maintenance*
- *to beat the clock on downtime*



There's no need to waste time and manpower rerolling and re-inspecting tubes when you have efficient Wilson Tube Expanders on hand. They make rolling of new tubes . . . rerolling of old tubes . . . quick and easy. These precision-manufactured tube expanders insure solid seating. They are available in all sizes, flaring and non-flaring types.



You can also count on getting fast, economical service from Wilson Tube Cleaners. They thoroughly remove even the toughest deposits from tubes of boilers, heat exchangers, stills, evaporators, etc. Tubes are left spic-and-span. And best of all, Wilson Tube Cleaners do their work in a hurry . . . help you beat the clock on downtime.

TWO BULLETINS—

Up-to-the-minute Tube Expander Catalog and 48-page Catalog describing complete Wilson Tube Cleaner line—are available. A single request brings both.

Representatives in all principal cities

THOMAS C. WILSON, INC.

21-11 44th AVENUE, LONG ISLAND CITY 1, N. Y.

Cable address: "Tubeclean" New York

WILSON

TW 707

TUBE CLEANERS • TUBE EXPANDERS

These EVERLASTING advantages give better service from

Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Angle Blowing Valve.

BOILER BLOW-OFF VALVES

When you install an EVERLASTING Duplex Blow-Off Unit, you'll find that its many superiorities speak for themselves.

The sealing valve at the left is the EVERLASTING design that has been famous for more than 40 years . . . the valve with the drop-tight seal that actually improves with use because of its self-lapping action each time the valve is opened or closed . . . the valve that can't stick or jam because of its non-wedge design . . . the valve that opens in less than a quarter turn to provide unimpeded straight-through blow.

The blowing valve at the right is the equally famous EVERLASTING Angle or "Y" Valve, specially designed and equipped to withstand repeated blow-off shocks, erosion and corrosion, and without pockets that might trap and hold solids.

Each of these valves . . . and all the other EVERLASTING Boiler Blow-Off valve types, fully meet ASME code requirements . . . assurance that they are properly designed and amply strong for the service.

Write for descriptive bulletin

EVERLASTING VALVE CO.
49 Fisk Street, Jersey City 5, N. J.

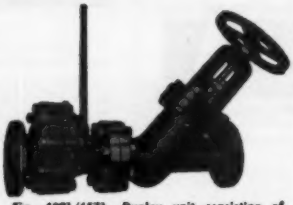


Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Y Blowing Valve.

Fig. 6571/6561. Duplex unit consisting of Y Sealing Valve and Angle Blowing Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Sealing Valve and Y Blowing Valve.

Everlasting Valves

TRADE MARK "EVERLASTING" REG. U.S. PAT. OFF.

EV-548

FOR EVERLASTING PROTECTION

Readers' guide to advertised products

(Continued from page 130)

ings and gaskets. Raybestos-Manhattan, Inc., Packing Div.

PIPE, TUBING & HOSE

Pipe Unions
Adv. p. 133 contains information on Dart unions. Dart Union Company.

Flexible Metal Connectors **573**
Booklet SS-50 describes American flexible metal connectors and their uses. The American Brass Co., American Metal Hose Branch, p 141.

Expansion Joints **541**
Bulletin contains specifications on Flexon expansion joints. Flexonics Corp., Expansion Joint Div. p 54.

Flexible Metallic Tubing **542**
"Flexineering" folder contains data on Penflex tubing. Pennsylvania Flexible Metallic Tubing Co. p 44.

Wing Unions **543**
Catalog contains data on Weco wing unions. Weil Equipment Mfg. Co. p 155.

HOW TO REQUEST FREE LITERATURE

Insert "key" numbers on return post card found on page 123. For quick reference to free literature offered by advertisers in this issue, refer to listing on page 138. Our Reader's Service Department will handle your request promptly.

PUMPS

Proportioning Pump **544**
Catalog UP-52 contains data on "U" type proportioning pump. Hills-McCanna Co. p 147.

Pumps
Adv. p 110 contains data on Weinman pumps. The Weinman Pump Mfg. Co.

Pumps **545**
Condensed Catalog "M" contains information on Aurora pumps. Aurora Pump Co. p 131.

Pumps
Adv. p 42 contains data on Worthington vertical turbine pumps. Worthington Corp., Vertical Turbine Pump Div.

Pumps
See Adv. p 148 for information on American-Marsh pumps. American-Marsh Pumps, Inc.

REFRACTORY CONCRETES

Refractory Cements **546**
Catalog describes R&I Moldit refractory cements. Refractory & Insulation Corp. p 145.

SOOT BLOWERS & TUBE CLEANERS

Tube Cleaners & Expanders **547**
Tube expander catalog and 48-page

(Continued on page 134)

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. . . to see and learn about the latest developments in . . .

HEATING • VENTILATING • AIR CONDITIONING

At Chicago's International Amphitheatre, from Jan. 26-30, you'll SEE *all* that's new, LEARN the latest trends and practices, GET a wealth of new ideas, and MAKE a host of valuable contacts during the 11th International Heating and Ventilating Exposition.

Over 300 technically-staffed exhibits will provide an exceptional opportunity for plant owners, managers, operators, architects, and engineers to get a first-hand look at the latest products for conditioning air in all types of buildings, plants, and homes . . . . compare hundreds of new, improved items, large and small . . . . find cost-saving solutions to problems by discussing them with engineering specialists . . . . get MONTHS AHEAD in FIVE DAYS.

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11th Air Conditioning Exposition
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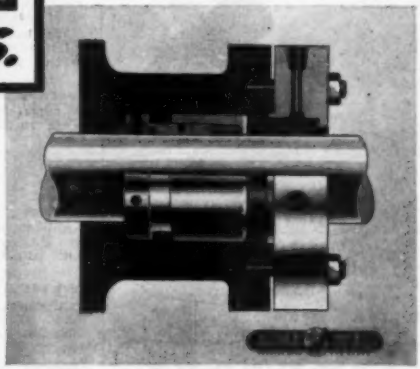
Under Auspices of American Society of Heating & Ventilating Engineers

MANAGEMENT INTERNATIONAL EXPOSITION CO.

DURA SEAL TYPE-P.S.

A Single Balanced Mechanical Seal for Light Hydrocarbons at High Pressures...



Now — perfect sealing for pumps handling light hydrocarbons up to 600 lb. pressures. Can be installed on your present equipment — no special sleeves or machining required.

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Send your sealing problems to us for free counsel

DURAMETALLIC CORPORATION
KALAMAZOO MICHIGAN

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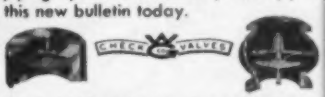
This important new Bulletin WH-851 explains in detail the causes and damaging effects of costly Water Hammer—and how it can easily be controlled with Williams-Hager Silent Check Valves. Learn how Water Hammer can be quickly and inexpensively controlled *in your piping system*—send for your copy of this new bulletin today.



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1620-22-24 Pennsylvania Ave., Pittsburgh 33, Pa.
Please send a copy of Bulletin WH-851 on "Water Hammer, Cause, Effect and Control in Piping Systems."

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IP-1252

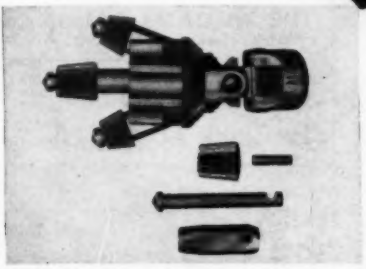
One of many reasons why skilled industrial maintenance workmen prefer

AIRETOOL TUBE CLEANERS

heads that really clean

There's no foreign deposit, in any size tube, straight or curved, that can't be quickly and completely removed by one of the many AIRETOOL tube cleaner heads. Precision made of special heat treated alloy steels, these AIRETOOL heads clean out even the hardest deposits, and restore tubes to their original efficiency. They are constructed with a minimum of parts for easy maintenance, and can be used with a variety of powerful motors for rapid, thorough tube cleaning. The versatility, variety and efficiency of AIRETOOL tube cleaner heads, are basic reasons why they can improve your tube maintenance program. For full details, write to: The AIRETOOL Mfg. Co., 318 S. Center St., Springfield, Ohio.

Wing arm head for cleaning scale, coke, lime or other deposits from curved tubes.



Due to their design and construction, AIRETOOL cleaner heads such as this forwardly swing arm type can be disassembled and put together again without special tools. The arms are designed to reach out to clean every part of the tube wall, and the large number of cutting surfaces insures a quick thorough tube cleaning job.

There's an Airetool Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

AIRETOOL MANUFACTURING COMPANY SPRINGFIELD, OHIO

BRANCH OFFICES: Philadelphia • New York • Chicago Tulsa • Baton Rouge • Houston • Hudson Heights (N.J.) REPRESENTATIVES in principal cities in U.S.A., Canada, Mexico, South America, England

Readers' guide to advertised products

(Continued from page 132)

catalog describes complete Wilson tube cleaner line. Thomas C. Wilson, Inc. p 131.

Tube Cleaners **548**
Bull J-410 contains data on Rotojet Junior tube cleaners. Elliott Co., Roto Div. p 126.

Tube Cleaners & Expanders **549**
Full details on Airetool tube cleaners and expanders. Airetool Mfg. Co. p 134.

STEAM SPECIALTIES

Impulse Steam Traps
Adv. p 66 contains data on Yarway impulse steam traps. Yarnall-Waring Co.

Steam Traps & Regulators **550**
Trap selector chart 145-4 and Cat 600-16 describes steam trapping and temperature control. Sarco Co., Inc. p 63.

Traps **551**
Cat 68-J describes complete line of Strong traps. Strong, Carlisle & Hammond Co. p 138.

Illinois Steam Traps **552**
Bull 35 contains data on Illinois steam traps. Illinois Engineering Co. p 131.

Steam Traps
Adv. p 158 contains information on Super-Silvertop steam traps. The V. D. Anderson Co.

THERMAL INSULATION

Ceramic Fiber **553**
Coupon on p 16, 17 offers free folder on new ceramic fiber with interesting possibilities. The Carborundum Co., Refractories Div.

Heat Insulation **554**
Free book available on "Kaylo Heat Insulation". Owens-Illinois Glass Co., Kaylo Div. p 49.

Rockwool Insulation **555**
Coupon on p 112 offers complete data on black rockwool insulation. Baldwin-Hill Co.

TURBINES

Turbines **556**
Bull 03B7654 contains complete details on WA-Series steam turbine generator unit. Allis-Chalmers. p 20, 21.

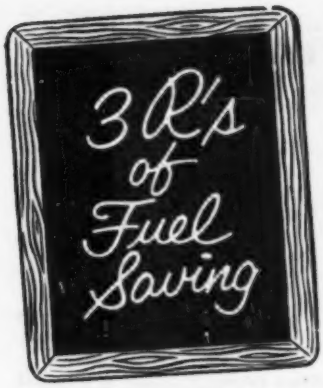
Turbines
Information on Worthington steam turbines. Worthington Pump & Machinery Corp., Steam Turbine Div. p 40.

Turbines
Adv. p 29 contains information on Type E turbines. Westinghouse Electric Corp.

VALVES

Butterfly Valves **557**
Valve catalog contains data on Rockwell

(Continued on page 138)



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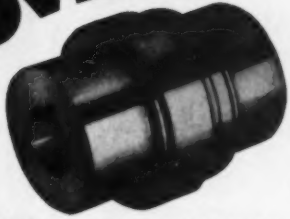

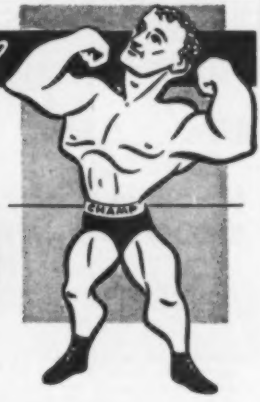

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Readers' guide to advertised products

(Continued from page 134)

butterfly valves. W. S. Rockwell Co. p 136.

Blow-Off Valves **558**

Bulls B-424 and B-433 contain information on Yarway blow-off valves. Yarnall-Waring Co. p 30, 31.

Pump Valves **559**

Catalog gives 4 ways to cut pump repairs. Sims Pump Valve Co., Inc. p 127.

Check Valves **560**

Bull 30 contains complete information on Chapman tilting disc check valves. Chapman Valve Mfg. Co. p 48.

Check Valves

Adv. p 7 contains data on the Crane steel vertical ball lift check valve. Crane Co.

Steel Valves **561**

Cat F-9 contains data on complete Vogt line of drop forged steel valves, fittings and flanges. Henry Vogt Machine Co. p 56.

Silent Check Valves **562**

Coupon p 133 offers Bull WH-851 "Water Hammer, Cause, Effect and Control in Piping Systems". The Williams Gauge Co.

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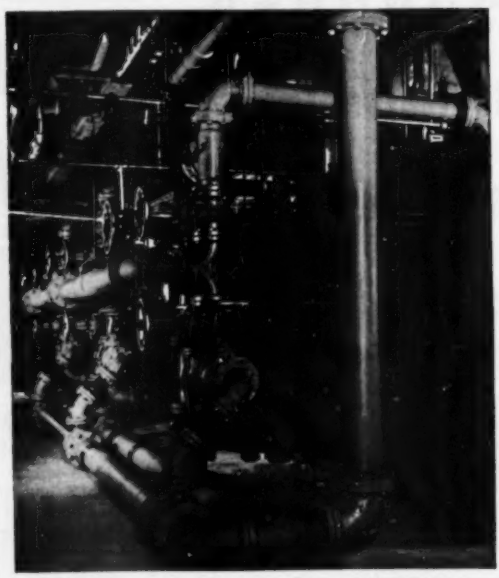

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Corrosion-Resistant Valves
See adv. p 26 for data on Aloyco corrosion-resistant valves. Alloy Steel Products Co., Inc.

Blow-Off Valves **563**
Bulletin describes boiler blow-off valves. Everlasting Valve Co. p 132.

WATER TREATMENT

Water Conditioning
Adv. p 104 contains data on Worthington hot-process water treating systems. Worthington Corp., Water Treating Section.

Demineralizers **564**
Information available on new all-plastic valve for controlling cycles of flow in American demineralizers. American Water Softener Co. p 143.

Water Treatment
Adv. p 11 contains data on the Nalco system of water treatment. National Aluminate Corp.

HOW TO REQUEST FREE LITERATURE

Insert "key" numbers on return post card found on page 123. For quick reference to free literature offered by advertisers in this issue, refer to listing on page 138. Our Reader's Service Department will handle your request promptly.

Demineralizer
Adv. p 121 contains information on the Graver demineralizer. Graver Water Conditioning Co.

Water Treatment Plants **565**
Bulletins available on manual and automatic water treatment plants. Hungerford & Terry, Inc. p 136.

Return Line Corrosion **566**
Bull 5013 outlines causes of return line corrosion and describes its control. Dearborn Chemical Co. p 39.

Water Conditioning Service **567**
Free technical paper No. 98 "Boiler Scale—Its Formation and Prevention". W. H. & L. D. Betz. p 15.

Belco Clarator **568**
Bull 108 contains complete data on the Belco clarator for waste treatment. Belco Industrial Equipment Div., Inc. p 118.

Water Treatment **569**
New booklet, "Drew Boiler Water Treatment" contains complete information. E. F. Drew & Co., Inc. p 51.

Demineralizer **570**
Full information available on automatic Mono-Column demineralizer. Penfield Mfg. Co., Inc. p 129.

Boiler Water Comparator **571**
Handbook on "Modern pH and Chlorine Control." W. A. Taylor and Co. p 6.

Water Conditioning
Information on Elgin water conditioning systems for every need. Elgin Softener Corp. p 139.

MISCELLANEOUS

Industrial Site **572**
Write for details on why Tuscaloosa would be a good location for your plant. New Industries Committee, Inc. p 146.

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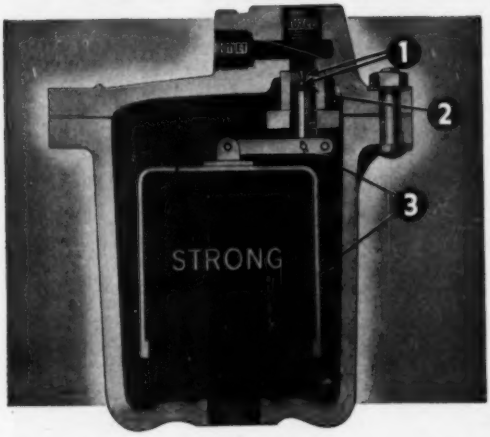

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70 Series Trap

"Y" Strainer

STRONG

QUICK REFERENCE TO BULLETINS & CATALOGS OFFERED BY ADVERTISERS IN THIS ISSUE

List "Key Numbers" on the postal card on page 123

Page No.	Advertiser	Catalog	Key No.
53	Acheson Colloids Co.	"Use of Colloidal Graphite for Metalworking Operations"	531
134	Airetool Mfg. Co.	Tube cleaners & expanders	549
20	Allis-Chalmers Mfg. Co.	Steam turbine generator unit	556
141	American Brass Co., American Metal Hose Branch	Flexible metal connectors	573
55	American Engineering Co.	Taylor stokers	527
143	American Water Softener Co.	Demineralizers	544
131	Aurora Pump Co.	Pumps	545
112	Baldwin-Hill Co.	Rockwool insulation	555
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15	Betz, W. H. & L. D.	"Boiler Scale, Its Formation & Prevention	567
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16	Carborundum Co., Refractories Div.	Ceramic fiber	563
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120	Clayton Mfg. Co.	Forced recirculation generators	535
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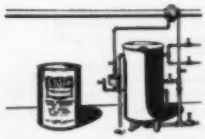
133	Williams Gauge Co., The	"Water Hammer, Cause, Effect & Control in Piping Systems"	562
131	Wilson, Inc., Thomas Co.	Tube cleaners & expanders	547
30	Yarnall-Waring Co.	Blow-off valves	550
107	Zink Co., John	Burners	525

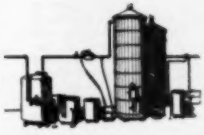
How'll you have your water?

Thousands say: "I'll take ELGIN"

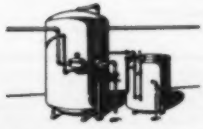
Here are a few Elgin Methods



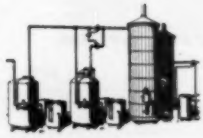
1 The simplest is chemical feed. In many cases individually prepared Elgin Chemical Treatment alone will do the job.



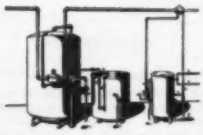
4 Water of low, controlled alkalinity, with CO_2 removed, can be produced by acid feed and degasification following zeolite softening.



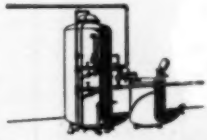
2 A zeolite softener is often the answer. It gives up to 44% more capacity if it's an Elgin "Double-Check".



5 Blended effluents from a sodium zeolite softener and a hydrogen zeolite softener, followed by degasification, give water in which total solids and alkalinity is reduced and CO_2 is removed.



3 A zeolite softener, supplemented by chemical treatment will not only eliminate hardness but also prevent corrosion.



6 Single-tank Ultra-Deionizer produces the equivalent of distilled water, free from silica and CO_2, at amazingly low cost.

THE answer to "How'll you have your water?" depends on whether *you* are drinking it or your *plant* is drinking it. When the water is for boilers or industrial processes, it pays to be all-fired particular about every drop of it.

That's where Elgin comes in: Elgin methods and equipment can take your raw water and "make it over" into water with the exact characteristics you require. Since Elgin systems embrace all sound methods, Elgin recommendations are necessarily unbiased. The only question asked is, — what method gives exactly what is needed at the lowest possible cost?

And nearly a half century of specialization goes into the Elgin answer to that vital question!

Some of the Elgin systems that may fit your needs are listed here . . . and there are many more that can be "tailored" to your specific needs.

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AIR & DUST FILTERS & COLLECTORS

Electrostatic Precipitator **200**

"The Inside Story," a 4-page folder, describes the design features of electrostatic precipitators developed for sodium salt recovery in soda and sulphate pulp mills. Discussed are such topics as the construction of inlet and outlet flues, wet bottom design, electrical equipment and discharge electrodes. Research Corp.

BATTERIES & CHARGERS

Stationary Batteries **201**

To help industrial users select and install the proper glass-jar batteries for control, alarm, switchgear and signalling services, 20-page brochure GB 852A has been prepared. Five pages are devoted to specifications on steel battery racks. The catalog portion discusses features, suggested uses and proper installation procedures for several types. Technical data, overall dimensions and weights are presented. Gould-National Batteries, Inc.

BUILDING HEATING, VENTILATING & AIR CONDITIONING & REFRIGERATION

Unit Heaters **202**

Capacity tables and roughing in dimensions for suspended type, gas fired unit heaters are presented in 4-page folder 23-2. Units with capacities from 55,000 to 400,000 Btu per hr are listed. The literature states that the heaters burn all types of gas. United States Air Conditioning Corp.

Dehumidifiers **203**

How surface and evaporative cooling is put to work in large surface dehumidifier units, for industrial buildings, is discussed in 32-page booklet 1660. Construction of the units, together with all information required for installation, is presented. A section, designed to aid in selection of the proper unit, presents all formulas, unit data, psychometric data and coil data for determining size. Sturtevant Div., Westinghouse Electric Corp.

Unit Heater Steam Traps **204**

"How to Select Steam Traps for Draining Unit Heaters," 8-page bulletin 231, tells how to figure condensing rates and select proper traps. The Btu output ratings for various models of unit heaters made by 30 different manufacturers are tabulated. To add to the value of the charts, constants are given for use when conditions are other than those specified. Armstrong Machine Works.

Unit Heaters **205**

Independent direct fired heating units are the subject of 8-page bulletin GNC. Oil, gas or combination oil-gas burners can be supplied. Advantages and typical applications are discussed. Construction is shown in a cutaway view. Specifications and dimensions are listed for models with output from 100,000 to 2,000,000 Btu per hr. Portable units as well as floor mounted and suspended types are shown. Prat-Daniel Corp., Thermobloc Div.

Unit Heaters **206**

Engineering data concerning selection and application of vertical and horizontal shaft unit heaters are tabulated in 48-page booklet 3570. Descriptions and applications of both types of heaters are given. Included is a section on motor controls showing typical wiring diagrams, and a section presenting piping illustrations and suggestions for both steam and hot water. Herman Nelson Div., American Air Filter Co., Inc.

COAL, ASH & BULK HANDLING

Screw Conveyer **207**

Descriptions of a screw conveyer, described as an automatic, money saving technique for handling coal, are presented in a 4-page folder. Photos of actual installations are employed to suggest applications. Canton Stoker Corp.

General Catalog **208**

Products for use in the chemical processing industries are described in a new catalog. Among the items listed are protective coatings, tank and pipe linings, plastic fittings, hose, pinch valves, packings, conveyer belts and expansion joints. Chemical properties, temperature limitations, sizes and recommended working pressures also are covered. Mechanical Goods Div., United States Rubber Co.

Pneumatic Systems **209**

General considerations in designing ash and dust handling systems for steam plants are outlined in 8-page brochure 652. A schematic drawing of a pneumatic system and concise descriptions of component parts are included. The Allen-Sherman-Hoff Co.

COMPRESSORS

Air Compressors **210**

Descriptions, design features and specifications for industrial air compressors are contained in 16-page brochure 5110-A. Models are for belt or direct motor drive from ½ to 100 hp. Accessories and controls also are described. Schramm Inc.

Feather Valve Compressors **211**

Heavy duty package type feather valve compressors from 75 to 350 hp are featured in 32-page booklet L-676-B1. Advantages, design, specifications, controls and accessories are discussed. Worthington Corp.

(Continued on page 142)

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Wire & Cable

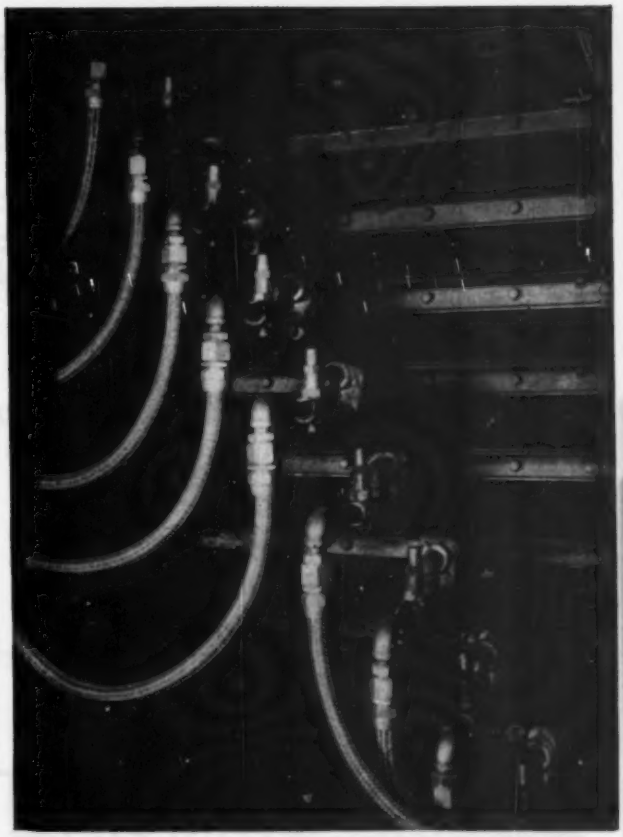
General catalog C-79, over 800 pages, is actually three books in one. Besides being a product catalog, it serves as a materials textbook and an engineering data handbook.

The product section contains specifications on a wide variety of wire and cable products together with electrical characteristics in some cases. The materials section tabulates the physical properties and electrical characteristics of conductors, insulations, coverings, and miscellaneous materials used in the various products. The engineering data section outlines necessary data to calculate almost any cable problem.

This electrical conductor handbook may be obtained by addressing a letterhead request to E. F. Luna, Sales Promotion Director, Anaconda Wire & Cable Co., 25 Broadway, New York 4, N.Y.

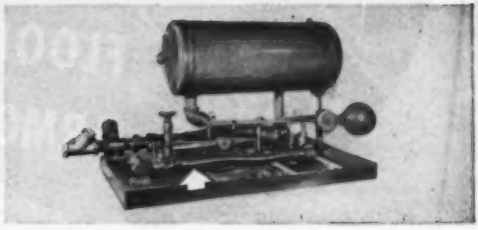
News about flexible metal connectors

Here they prove dependable for PRESSURE, COLD and HEAT



PRESSURE Harbor Plywood's veneer press uses American ½" I.D. Seamless Bronze Connectors with braid for added pressure resistance. American Flexible Metal Connectors are ideal for this use because they're corrosion-resistant. They come with fittings attached and are easily installed. Manufacturers, like Harbor Plywood, find American Connectors the right solution to tough design problems because of their flexibility, both in assembly and operation, and their long life with little maintenance attention.

COLD For conveying Freon in truck refrigeration systems, The Schnabel Co. uses American Vibration Eliminators. These connectors operate between 10° and 40° F. at 180-200 p.s.i. American Flexible Metal Connectors are the best answer where moving lines must be connected, flexible shafts protected, or assemblies made in restricted spaces.



HEAT Morehead Manufacturing Company uses American Seamless Bronze Flexible Connectors on their "back to boiler" steam trap. This connector has the ability to resist high steam temperature and pressure as well. American Flexible Metal Connectors may also be used to carry corrosive liquids, gases, or semisolids.

WRITE FOR BOOKLET SS-50—*shows how the tubing is designed, used, and installed—gives specifications on tubing and fittings. The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn. In Canada: The Canadian Fairbanks-Morse Company, Limited.*

wherever connectors must move... *American* flexible metal hose and tubing

New bulletins and catalogs

(Continued from page 140)

Refrigeration Compressors **212**

Hermetically sealed refrigeration compressors and condensing units are described in 8-page bulletin DB 101-160. Construction and design of units of 75 to 100 hp capacity are described. Available accessories are listed. Specifications are tabulated, and line drawings give over-all dimensions. Sturtevant Div., Westinghouse Electric Corp.

Compressors **213**

Basic application data and design specifications for multi-stage, multi-cylinder compressors from 100 to 5000 hp are contained in 44-page engineering catalog M-70. Topics discussed include design features, lubricating system, bearings and counterweights, cylinders, motors and drives, automatic control, and typical installations. The Cooper-Bessemer Corp.

Air & Gas Compressors **214**

Construction of compressors developed for applications requiring oil-free compressed air or gas is shown in 4-page folder 600. Units incorporate steel-backed carbon cylinder liners. They are horizontal single-stage, double-acting and horizontal double-acting, two stage types. Pennsylvania Pump and Compressor Co.

Over 7,000,000 Sq.ft.

Protect the Nation's Industrial Floors!

KLEMP
We Tread the World with Safety

Such universal acceptance is no accident! Klemp's patented reinforcement armors eliminate chipping, cracking, creeping, splintering, spalling, and disintegration. Ruts and pot-holes do not form. They provide countless industrial users with the solidest, safest, most enduring floors of accurate level. This is why Klemp floors are still in perfect condition after more than 25 years! You, too, can protect *your* floors by following these two simple steps: (1) send for the free Klemp booklet: "Instructions for Laying Klemp HEXTEEL and FLOORSTEEL"; (2) call upon Klemp's free engineering service. ACT TODAY!

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EXECUTIVE OFFICES 1377 NORTH BRANCH STREET, CHICAGO 22, ILLINOIS

CONTROLS, REGULATORS & INSTRUMENTS

Flow Meter **215**

Widely fluctuating flows, dirty fluids and other types of difficult fluids can be measured with a pneumatic electric flow meter, according to 4-page folder 704. Operation with pressures to 2000 psi and differential pressures from 0.6 to 704 in. of water is listed. Hook-ups, meter components and applications are discussed. Republic Flow Meters Co.

pH Meters **216**

Every industry can utilize some form of pH control to increase operating efficiency, reduce waste and improve product quality, according to 28-page brochure 86-J. Published to guide the engineer in selecting the proper meter, it discusses the advantages, operation and applications of four types of instruments. Included is a portable meter for use in the field and an automatic unit for indicating, recording and controlling pH in processing operations. Beckman Instruments, Inc.

Controllers & Pilots **217**

Discussed in catalog section 110 are various types of time cycle, pressure and manual remote controllers together with vacuum and safety shut-off pilots. This edition has been revised to show a recently developed pressure controller and a new safety shut-off pilot. Black, Sivalls & Bryson, Inc.

Electronic Controls **218**

Electronic instruments for automatic control of process variables are the subject of 6-page folder A-702. Included is information on principles of operation, design, specifications, applications and installation. A second folder, A-705, describes manual controls for remote operation of final control elements, to be used with the control system. The Swartwout Co.

Temperature Recorders **219**

Details of construction, contained in 20-page booklet 447, show how each component part contributes to the accuracy of temperature recorders. Data are included to assist in the understanding, selection and use of temperature measuring instruments. Reference charts and text explains the characteristics of vapor pressure, gas pressure and liquid expansion systems. Information and brief descriptions of indicating and controlling temperature instruments also are included. The Foxboro Co.

Measuring Instruments **220**

Described as a handbook for engineers concerned with non-control precision measuring instruments, 46-page catalog 1520 presents factual information and specifications on many types of units. The instruments employ many types of circuits, such as potentiometers and Wheatstone bridges to measure temperature, pressure, flow, pH and many other variables. Instruments for special purposes also are briefly described. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

DIESELS

Diesel Units **221**

Series of 12 specification sheets 208-219, describe one, two and three cylinder diesel engines in the 10 to 45 hp range—1200 to 1800 rpm. Units described include diesel generator unit, engine with stub shaft, engine with clutch power take-off and pump unit for each type of engine. Nordberg Manufacturing Co.

ELECTRICAL DISTRIBUTION

Electrical Equipment **222**

Equipment for the generation, transmission, distribution and utilization of electric power in oil field and pipeline applications is described in 20-page booklet GEC-926. The operational problems of drilling and pumping are discussed, and recommendations are made to meet specific needs. Charts, tables and graphs are included. General Electric Co.

Circuit Breakers **223**

"What You Should Know About Circuit Breakers," 16-page manual 101, explains the operating principles of basic circuit breaker designs. Included are simplified diagrams of three basic types. Explanations, charts and diagrams deal with temperature factors, inrush current effects, tripping and reset time, quick and slow make-and-break, and wire deterioration rates. Heinemann Electric Co.

HOW TO REQUEST FREE BULLETINS

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Aluminum Wire **224**

To answer the need for accurate information about aluminum electrical wire and cable, the National Electric Contractors Assn. has published an 8-page article, "Report on Aluminum Electrical Conductor." It points out problems involved when using aluminum conductors, and their solutions. Factors governing the choice of aluminum or copper for wire, cable and bus also are listed. The Thomas & Betts Co.

Magnetic Amplifiers **225**

Magnetic amplifiers are assuming an important role in systems which require reliable, static power amplification, according to 18-page bulletin TD-52-600. A definition of magnetic amplifier terminology is given, followed by an explanation of the theory of operation. Curves, tables and wiring diagrams deal with component parts, applications and operating characteristics for various types of magnetic amplifiers. Westinghouse Electric Corp.

Safety Switches **226**

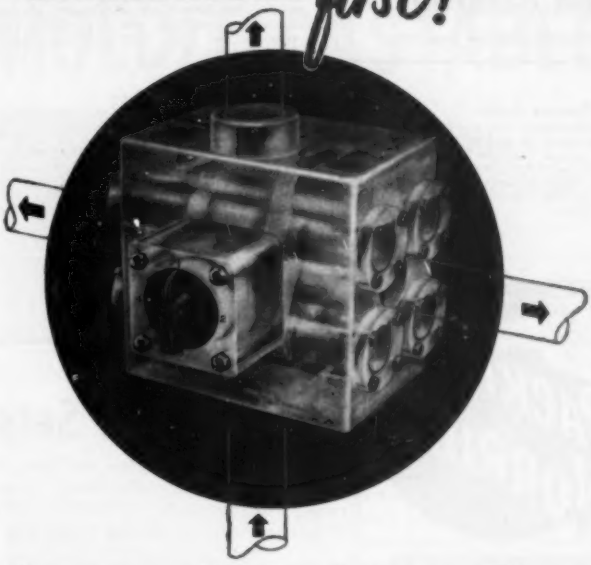
Front operated safety switches with general purpose, weather resistant and raintight enclosures are featured in a 12-page bulletin. Units are described for service from 30 to 1200 amp. Operating features and design are described, and specifications are tabulated. Federal Electric Products Co.

Electrical Wiring **227**

"Safety Mineral Insulated Wiring System," 24-page booklet, contains the history and explanation of outstanding characteristics and applications of this wiring system. The wiring is described as being made up of one or more conductors, spaced and insulated with a non-combustible mineral insulation and encased in a seamless metallic tubing. General Cable Corp.

(Continued on page 144)

an AMERICAN *first!*



the *new* all-plastic CYCLOFLOW

- *fingertip control!*
- *can't corrode!*
- *can't contaminate!*

Developed by American for controlling cycles of flow in ion-exchange equipment, the CYCLOTROL, a new all-plastic single control valve, is completely impervious to acids and alkalies. Manufactured of inert materials, it eliminates the costly problems of corrosion.

The CYCLOTROL assures complete protection for the extremely high purity of the water obtained from American Demineralizers. It eliminates the possibility of contamination from raw water or corrosion products, by providing an isolated section connected to waste between the outlet and all sources of contamination.

Requiring a minimum of torque for operation, the CYCLOTROL is ideally adapted to either manual or automatic control. Positive valve action is provided with four double acting pistons actuated by a simple integral fingertip control. The American design eliminates spring loading and large unbalanced areas and flat surfaces which inherently result in leakage.

The CYCLOTROL can be completely disassembled with a pocket wrench in 15-20 minutes without removing piping connections.

Complete details on this new valve development are available on request. Write today for information.

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AMERICAN *Water Softener* COMPANY
INCORPORATED

FOURTH AND LEHIGH AVENUE • PHILADELPHIA 33, PENNSYLVANIA

DEAERATORS • HOT PROCESS SOFTENERS • REACTORS • FILTERS • ZEOLITE SOFTENERS • CHLORIDE DEALKALIZERS • AERATORS & DECASIFIERS
HYDROGEN SODIUM ZEOLITE SOFTENERS • DEMINERALIZERS • CHEMICAL FEEDERS • CONTINUOUS BLOWDOWN • SWIMMING POOL EQUIPMENT

New bulletins and catalogs

(Continued from page 143)

Multi-Purpose Cable **228**

Specifications for multi-purpose cable are tabulated in 4-page folder RR-1. The cable, which features heat and moisture resistant insulation plus a Neoprene sheath, can be installed aerially, in ducts, on open racks or by direct earth burial. Rome Cable Corp.

Circuit Breakers **229**

"How Much Can a Breaker Take?", 8-page reprint 71R7855, describes results of recent field tests conducted on a standard 69 kv, 1500 mva oil circuit breaker. Photos, drawings, diagrams and data tables supplement the text. Allis-Chalmers Manufacturing Co.

ENGINES

Dual Fuel & Gas Engines **230**

Construction, operation and application features of 9 and 13 in. bore, 4 cycle, diesel dual fuel and spark-fired gas engines are contained in 12-page bulletin 205. Pressure lubrication, high velocity cooling, fuel systems and design characteristics are described. A cross section drawing shows the design. Ratings, weights, dimensions and standard equipment are tabulated. Nordberg Manufacturing Co.

FANS & BLOWERS

Centrifugal Compressors **231**

Single stage centrifugal compressors from 30 to 600 hp are the subject of 12-page brochure 109. Units for pressures from 1.25 to 3.75 psi are listed for inlet volumes from 4410 to 28,700 cfm. The booklet covers functions, applications, ratings, design features, arrangements and control methods. American Blower Corp.

FILTERS, STRAINERS & PURIFIERS

Liquid Filters **232**

Specifications, engineering data and performance data describing liquid filters for water, chemicals and petroleum products are contained in 12-page bulletin D-IL. Types of filter media are described. A list of liquids which can be filtered also is presented. Dollinger Corp.

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

Oil Reclaimer **233**

Advantages, construction and operation of oil reclaimer and conditioning systems are described in bulletin R-375. The units are direct connected to turbine reservoir or oil tanks for continuous operation, or to dirty or clean oil tanks for batch operation. All settling tanks and pretreatment of the oil are eliminated, according to the literature. The Hilliard Corp.

Lubricators **234**

Force feed lubricators for all types of machinery are described in 16-page catalog L-52. Details of design and construction, as well as specifications, are presented for open and enclosed types with capacities from 2 to 32 pints with 1 to 24 feeds per unit. Hills-McCanna Co.

PIPE, TUBING & HOSE

Expansion Joints **235**

Basic designs of corrugated expansion joints are described in 20-page brochure CMH-127R. A table of thermal expansion, together with discussions of design considerations, tables of axial and lateral motion, descriptions of construction materials, diagrams of typical installations and installation data, is presented to aid engineers in proper selection and application. Specifications for many types are tabulated. Flexonics Corp.

Pulsation Dampener **236**

Described in 4-page folder PDS-8501 are pulsation dampening piping systems designed for any type gaseous stream at operating pressures from vacuum to 5000 psi and at any temperature. Advantages and principles of operation are discussed. The Fluor Corp. Ltd.

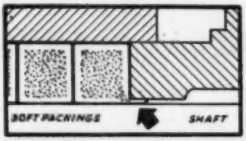
Insulated Pipe **237**

Applications for pre-sealed insulated pipe, described in 4-page folder 6C, in-

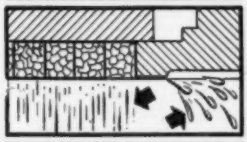
..try JOHN CRANE

Combination Sets

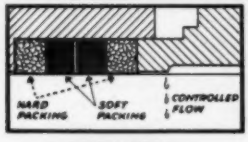
In the majority of cases, no one type of packing is 100% efficient. Therefore, "John Crane" recommends COMBINATION SETS to assure proper sealing. Here's why:



Straight soft packing used throughout permits end rings to squeeze into gland and throat clearances, thus sealing off the required amount of leakage needed to serve as lubricating film between shaft and packing.



Straight hard packing used throughout often is not sufficiently sensitive to gland pressure to control leakage within the desired limits. Also, the use of this single type of packing may result in scoring the shaft.



The right combination, however, of two types of "John Crane" packing offers better sealing, increased shaft life and less down-time in a variety of services. That's because soft inner rings are employed to provide a positive seal—yet allow Controlled Flow Lubrication, while harder end rings serve as a dam to stop inner ring extrusion.

...IN THE **POWER PLANT**

HERE'S THE RIGHT PACKING COMBINATION FOR CENTRIFUGAL CONDENSATE AND DRAIN PUMPS

End rings of "John Crane" twisted metallic packing Style 101-M and intermediate rings of "John Crane" Super Seal #1 is the combination best suited for steel shafted pumps handling hot water at medium pressures. Order a test set today and prove to yourself its advantages over your present packing.

Send Today for Full Details

CRANE PACKING COMPANY

1831 CUYLER AVENUE DEPT. IP-12 CHICAGO 13, ILLINOIS

clude underground and weather exposed piping systems conveying hot or cold liquids, gases and steam up to 1000 psi. The bulletin gives applications, special features, construction, fabrication and specifications. Durant Insulated Pipe Co.

Flexible Metal Hose **238**

Quick reference catalog CC-400, 16 pages, contains brief descriptions of seamless and strip wound flexible metal hose and tubing. Specifications for fittings also are presented. Materials of construction, suggested applications and engineering data are listed in tables. American Metal Hose Branch, The American Brass Co.

Fabricated Fittings **239**

Published to serve as an aid in planning pipe and equipment layouts, 4-page folder 525 describes various standard and special fabricated fittings. Specifications and prints are given on standard units for light weight pipe. Illustrations of special fabrications are shown to suggest possible applications. Naylor Pipe Co.

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Welded Steel Pipe **240**

Data contained in 42-page reference manual 1M should be of value to all pipe users. Tabulated in this booklet is information on fittings, field joints, protective coatings and types of fusion welded steel pipe for water, oil or gas from 4 to 36 in. diam. Such engineering data as a flow chart and tables of safe working pressures add to the publication's value. Southern Pipe & Casing Co.

Insulated Piping **241**

Prefabricated, insulated piping systems, for underground piping of steam, hot water, oil, process liquids and gases, are the subject of 4-page folder 5205. Advantages, construction, applications, types of joints and typical installations are discussed. Also presented are prefabricated tunnel systems, manholes and sectional conduit systems for protection of underground insulated piping. The Ric-wiL Co.

Industrial Hose **242**

Application selection and installation of industrial hose assemblies, couplings, stems, swivels and accessories are described in 24-page catalog 52. According to the literature, the hose is designed for a broad range of industrial applications, including high pressures and temperatures and excessive flexing. J. N. Fauver Co.

HEAT EXCHANGER EQUIPMENT

Heat Exchangers **243**

Various types of heat transfer equipment are among the products described in 12-page catalog 12. Also presented are various types of dry blending equipment and such process equipment as kettles, evaporators, vessels, reactors and coils. Specifications are included. The Patterson-Kelley Co., Inc.

Surface Condensers **244**

Opening with an explanation of the design, 23-page booklet B-4330 describes radial flow surface condensers. Operation and construction are fully discussed and illustrated. Accessories and testing facilities are listed, together with brief descriptions of actual installations. Westinghouse Electric Corp.

(Continued on page 148)

PLANT AFTER PLANT FINDS

MOLDIT CASTABLES

Guniting the floor of a big power boiler with a 9½" thickness of Moldit Chrome Refractory Cement.

Center arch fire box of a boiler poured with Moldit-O Refractory Cement.

Pour—Gun—Patch with MOLDIT

- Boiler furnace wall linings, doors, arches, baffles, ash pit walls, hoppers, stoker gate tile, burner blocks, header tile, etc.
- Air preheater monolithic floors.
- Coke Oven door linings, sectional or block; standpipes.
- Industrial furnace walls, arches, floors, hearth, piers, combustion tile, linings, covers, doors, etc.
- Special refractory shapes and linings for water, gas generators, cracking stills, retorts, incinerators, etc.

√Easier to Mix and Pour or Gun
√Set Stronger
√More Heat Resistant
√Last Longer

Moldit Refractory Cements—mixed and poured, gunited, troweled or plastered right on the job—make special shapes and monolithic linings of any size, and patches on spalled or eroded old linings that really cut labor and maintenance. Plant after plant reports improved resistance even under severe spalling, heat erosion, slagging or rapid temperature changes.

Moldit cold sets quickly to full strength—does not shrink, is impervious to water—outlasts 'em all!

Whether Large or Small
SAVE TIME ON THE JOB
CUT REFRACTORY COSTS
with **MOLDIT**
There's a Type for Every Service Application

Test MOLDIT Yourself *Mail This Coupon*

Please send at once
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Address_____
City_____ Zone____ State____

REFRACTORY & INSULATION CORP.
130 WALL STREET • NEW YORK 5, N. Y.

New bulletins and catalogs

(Continued from page 145)

Heat Exchangers **245**

"How to Select a Heat Exchanger," is the title of a data section included in a 16-page bulletin. Design features, construction, advantages, specifications and applications of various types of heat exchangers are included. Evaporators, feedwater heaters, pressure vessels and fabricated plate work, prefabricated piping and welded steel pipe are described. Alco Products Div., American Locomotive Co.

FUELS & FIRING EQUIPMENT

Spreader Stokers **246**

Engineering data concerning spreader stokers installed to burn refuse or wood are contained in 24-page booklet 505. Photos and side elevation drawings show special features. Stationary, manual dumping, power dumping and traveling grate installations having maximum capacities from 10,000 to 275,000 lb steam per hr are described. Detroit Stoker Co.

INSTRUMENTS FOR MEASURE OF ELECTRICITY

Hook-On Instruments **247**

Applications, operation and basic features of hook-on instruments are discussed in 8-page bulletin GEC-901. Instruments described include a volt-ammeter, wattmeter and power factor meter. General Electric Co.

MATERIALS OF CONSTRUCTION

Plastic Products **248**

Plastic, available as pipe moldings, extrusions or fabrications, is described in a booklet as possessing toughness and high impact strength without sacrificing stiffness. The formulation and processing can be varied to produce different properties. Many successful applications are listed. New York Belting and Packing Co.

Grating **249**

Published to show applications for grating in the oil refining and chemical industries, a 4-page folder describes two types of grating together with four types of stair treads. Several recently developed types are listed. Technical information includes engineers' diagrams, a safe load table for grating, and a diagram showing installation of two patented meshes for reinforcement of ganister linings. Klemp Metal Grating Corp.

MECHANICAL POWER TRANSMISSION

Speed Reducers **250**

Shaft mounted speed reducers with capacities from 1 to 43 hp are the subject of 20-page brochure A-614-A. Output speeds for the units range from 12 to 330 rpm. An overload release, developed to use with the reducers, is also featured. In addition to discussions of construction and operation, engineering information and selection data are presented. Dodge Manufacturing Corp.

Belt Drives **251**

V-belts, sheaves and adjustable speed drives are featured in 20-page bulletin WBC 7-52. Special design features such as a tapered split bushing and taper-bored hub, are described. Advantages, construction and installation also are discussed. Specifications are listed. The American Pulley Co.

Speed Reducers **252**

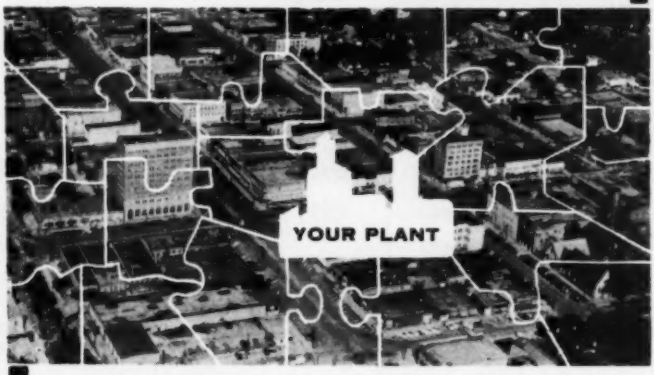
Engineers working with worm gear speed reducers will find a valuable source of reference in this 180-page book 400. Complete engineering specifications for single and double reduction units are given, together with discussions of advantages, applications, and installations.

Design features of component parts are described, and many special unit designs are presented. A detailed index adds to the book's usefulness. The Cleveland Worm & Gear Co.

Flexible Couplings **253**

Chain type flexible couplings are described in a 6-page folder. A straight and a diagonal type are featured. Listed in a table of dimensions are stock bores from ½ to 2¼ in. with maximum bores to 5⅞ in. A table of ratings lists horsepowers to 651 and speeds to 3600 rpm. Aluminum covers for the units also are described. Ramsey Chain Co., Inc.

ONE PIECE MISSING



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We've found that one industry leads to another. If you can sell to Tuscaloosa plants, or use a product they manufacture, it is likely that Tuscaloosa will be a good location for you. Take a careful look at Tuscaloosa industry, our skilled Southern labor and natural resources. Maybe you belong in the picture! Write for details.

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NEW INDUSTRIES COMMITTEE, INC.

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PACKAGED STEAM GENERATORS

Water Tube Boilers **254**

Construction and design features of 2-drum water tube boilers with integral water wall elements are described in 20-page brochure SB43. Factory assembled units, up to 300 hp, are described for underfeed stoker, spreader stoker, oil or gas firing. Larger units for field erection also are discussed. Actual installations are presented. Erie City Iron Works.

Packaged Steam Generators **255**

Facts concerning construction and operation of a shop assembled water tube boiler are presented in 6-page folder B-3275. Front and side elevation drawings give dimensions. Burners can be supplied for most types of oil and gas, or for combination oil and gas. Capacities are 7800 to 27,500 lb per hr. The Titusville Iron Works Co., Div. of Struthers Wells Corp.

PACKINGS & GASKETS

Mechanical Packing **256**

Included in 20-page catalog PC-102 is an application chart which provides a quick and accurate means of determining the proper packing for a specific service condition. Data, structure and performance of self-lubricating, molded, sheet and Teflon packings are presented. Greene, Tweed & Co.

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PUMPS

Vertical Pumps **257**

Construction features of small vertical pumps for sidewall or submerged mounting are described in 8-page bulletin 52B-6975A. Units are listed in capacities to 250 gpm at heads to 125 ft for such service as coolant circulating and air conditioning. Necessary data for determining motor frame, horsepower, speed and current characteristics are included. Allis-Chalmers Co.

Rotary Pumps **258**

Installations, operation and maintenance of rotary pumps are covered in 12-page service manual 100-3. Subjects discussed include installing foundation bolts, alignment, supporting vertical pumps, grouting, piping, suction lines, hot liquid pumps, rotation, packing, dismantling, reassembly, starting, operation and standing idle; also various charts and sectional elevation drawings. Warren Steam Pump Co., Inc.

Centrifugal Pump **259**

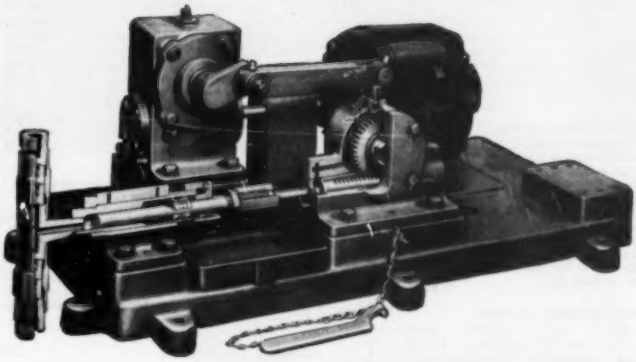
Seals and stuffing boxes are eliminated in a recently developed centrifugal pump described in a 4-page folder. A large cutaway view shows construction details. Many advantages gained by the new design are outlined. According to the bulletin, the unit will handle any clear liquid and many slurries. Chempump Corp.

Centrifugal Pumps **260**

General purpose, cradle-mounted centrifugal pumps are the subject of 16-page brochure 7223. Five basic cradle groups and 17 corresponding pump types are presented. Capacities of 5 to 3400 gpm are listed for pressures of 10 to 500 ft total head. Dimensions, applications and a table of performance are included. In addition, special purpose units and design modifications are described. Ingersoll-Rand Co.

(Continued on page 148)

For precisely controlled metering and proportioning of small volume flows...

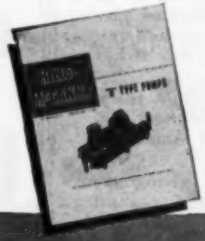


...the HILLS-McCANNA "U" Type Proportioning Pump

- The Hills-McCanna "U" Type Pump is designed to continuously meter and proportion small flows of the order of 0.10 to 24 gallons per hour per feed. Its accuracy and reliability suit it for research, pilot plant operation and full scale processing alike. The "U" type pump is suitable for batch or continuous operations.

Typical examples of "U" type pump applications include:

- Continuous addition of air entraining agents during cement manufacturing operations.
- Continuous injection of internal phosphate treatment and sodium sulphite oxygen scavenging in boiler plant water treatment.
- Injection of gasoline gum inhibitors into finished gasoline.
- Proportioning low molecular weight polymers and catalyst solution in resin research.



The new "U" Pump Catalog, UP-52, gives full information on the "U" type pump plus extensive application data including specific service recommendations for handling over 300 substances. Write for your copy, today. HILLS-McCANNA CO., 2355 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA

metering and proportioning pumps

Also Manufacturers of: Saunders Patent Diaphragm Valves Force Feed Lubricators • Magnesium Alloy Sand Castings

New bulletins and catalogs

(Continued from page 147)

Centrifugal Pumps 261

Descriptions and typical applications of many types of self-priming and straight centrifugal pumps are presented in 4-page reference bulletin G-32. Also described are diaphragm and plunger sludge pumps. Marlow Pumps.

Centrifugal Pumps 262

Integral construction of pump and motor is featured in the design of a close coupled centrifugal pump described in 8-page brochure 200-B. Advantages are discussed. Mounting in any position is possible, according to the bulletin. A selection table lists capacities of 30 to 110 gpm with heads of 110 to 200 ft. Dimensions are tabulated. Useful tables listing friction of water in pipes and fittings also are presented. Carver Pump Co.

Proportioning Pumps 263

Heavy duty chemical proportioning pumps are the subject of 8-page bulletin 1225. Furnished as self-contained units, they have one, two or three measuring chambers for capacities to 57 gph. The bulletin gives specifications and features together with installation diagrams, applications and operating data. %Proportioneers, Inc.%

High Pressure Pumps 264

Construction features of direct drive and back geared high pressure pumps are shown in cutaway views contained in 6-page folder 295. In addition to hydraulic machinery, applications such as high pressure boiler feeding and testing and back washing of pipes, valves and vessels are listed. Specifications are discussed and tables list capacities of 1.1 to 16.5 gpm for pressures of 600 to 5000 psi. American-Marsh Pumps, Inc.

Chemical Transfer Pump 265

Described in 6-page folder B-1606 is a semi-open impeller centrifugal pump for continuous or intermittent light duty in transferring process chemicals. Construction and advantages are described. Capacity, listed in a specifications table, ranges from 10 to 250 gpm for heads of 10 to 140 ft and temperatures to 250 F. A unit for higher pressures, temperatures and capacities also is described. Food Machinery and Chemical Corp., Peerless Pump Div.

MOTORS & GENERATORS

Diesel Generator Sets 266

Applications and advantages of diesel electric generator sets are discussed in 8-page booklet 30349. Listed in a table are externally regulated units from 20 to 315 kw and self-regulated models from 21 to 100 kw, based on 12 hr duty. Caterpillar Tractor Co.

Motor Controls 267

Described in a 4-page folder is the progress in design of magnetic motor controls made by this manufacturer. Design features of 1930, 1940 and 1952 models are discussed. Advantages of the modern design are stressed. Industrial Control Div., The Arrow-Hart & Hegeman Electric Co.

Turbine-Generators 268

Because demands for industrial turbine-generators vary considerably, 20-page booklet B-5418 describes the six primary types. Installation data on representative applications in the textile, manufacturing, metals, paper, petroleum, lumber, chemical and process, and food industries are presented. Westinghouse Electric Corp.

Motor Selector 269

Detailed information on EMC and Cyclohm fractional motors in ratings from 1/2000 to ½ hp is provided by a slide rule

selector. It is said to provide all data necessary for determining which motor will best meet any given set of requirements. Howard Industries, Inc.

Vertical Motors 270

Industrial users of deep well turbine pumps will find many interesting developments in vertical motor design contained in 16-page bulletin F1454. Cutaway views, in full color, illustrate construction of vertical motors from 1½ to 400 hp. U. S. Electrical Motors, Inc.

Eddy-Current Machinery 271

"Basic Principles of Eddy-Current Machinery," a section of 16-page bulletin GB1, explains the fundamental principles of generating torque by means of eddy-current devices. Another section, "Characteristics of Rotating Equipment," contains

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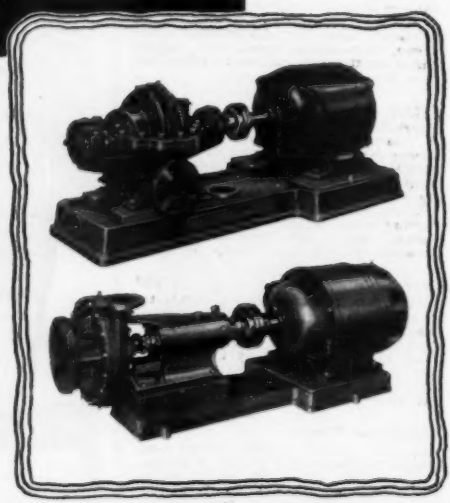

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engineering data. Descriptions are included of typical eddy-current equipment such as adjustable speed drives, couplings, brakes, dynamometers and clutches. Dynamatic Corp.

Electric Power Drives **272**

"Motor-Drive Is More Than Power," 4-page folder A-2703, is intended to serve as an introduction to the company's principal products. Included are brief descriptions of a-c motors from ¾ to 300 hp; heavy duty d-c motors from ¾ to 100 hp; all-electric adjustable speed drives for a-c circuits, from ¾ to 300 hp, and electronic controls and regulators for this motor-drive system; and motor-generator sets, generators, and rotating type regulators. Reliance Electric & Engineering Co.

Motor Controls **273**

"Industrial Motor Controls," 186-page catalog, presents information on a line of motor controls including magnetic starters, multi-speed and reversing starters, magnetic contactors and reversing contactors. Design features, weights and dimensions are included. Information on manual starters, push button stations and interchangeable control units, midget relays, limit switches and push-pull selector switches also is included. The Arrow-Hart & Hegeman Electric Co.

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Motor-Generator Sets **274**

Engineered motor-generator sets for all industries form the subject of 4-page bulletin F-2502. Briefly described are shunt or compound wound sets from ¾ to 1000 kw—built to provide power for constant or adjustable voltage systems and engineered to include synchronous or induction motors. Typical applications show their utilization for large single motor drives, excitation of synchronous machinery, multi-motor drives, and spot conversion—an economical means of supplying d-c power at the point of use. Reliance Electric & Engineering Co.

WATER TREATMENT

Filters **275**

Described in a 22-page brochure are several types of sand filters, including vertical and horizontal pressure types and a horizontal multiple-cell type. Advantages, operation, specifications and information on how to size are included. Refinite Sales Co., Div. of The Refinite Corp.

Waste Treatment **276**

"Industrial Waste Treatment Guide," 8-page bulletin B-I-F 4, contains a highly useful table showing the different types or combinations of unit treatment processes for more than 50 wastes. Other tables show equipment used in several unit treatment processes. A flow diagram shows how various treatment processes and equipment may be combined to treat mixed wastes. Builders-Providence, Inc.

Boiler Water Treatment **277**

Difficulties caused through industrial water contamination are outlined in a 12-page catalog. Recommended water conditioning treatments for scale, sludge, corrosion, carryover and other boiler conditions, and efficient control methods are described. Details on a system of complete boiler water conditioning are fully explained. E. F. Drew & Co., Inc.

(Continued on page 151)

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THE COMPETITIVE SYSTEM DELIVERS THE MOST TO THE GREATEST NUMBER OF PEOPLE

New bulletins and catalogs

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REFRACTORIES

Super Refractories 278

Refractory materials providing a wide range of properties are described in 20-page booklet 5120. Properties such as corrosion and abrasion resistance, hot strength, chemical inertness and thermal conductivities are discussed. Quick reference tables aid the engineer in selecting the proper material. Refractories Div., The Carborundum Co.

STEAM SPECIALTIES

Steam Traps 279

"Vacuum Isn't Vacuum to a Steam Trap," 4-page folder 223, discusses the following questions in relation to steam traps: What is vacuum? How does it affect trap operation? How does it influence trap selection? Will vacuum suck the prime out of traps? Does flash steam from traps destroy vacuum? What are common causes of loss of vacuum? Armstrong Machine Works.

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TRANSFORMERS

Dry Type Transformers 280

"Dry Type Transformers for Industrial Control," 8-page bulletin T-5111, describes construction and advantages of control circuit transformers. Units for primary voltages to 5000 v, 50 or 60 c, with ratings from .05 to 10 kva are listed. Included in the engineering data are regulation curves, wiring diagrams and a table of impedances. Hevi Duty Electric Co.

VALVES

Check Valves 281

Stop, check and non-return valves are the subject of 16-page catalog 12-H. Descriptions, design features, construction, specifications and dimensions for each type, in sizes from 2½ to 14 in. and in 600, 900, 1500 and 2500 lb pressure classes, are presented. Edward Valves, Inc.

MISCELLANEOUS

Industrial Lighting 282

Engineers concerned with industrial lighting should find the 1952 edition of the RLM standard specifications, 44-page booklet, of considerable value. Presented are detailed specifications of 18 of the most commonly employed incandescent and fluorescent industrial lighting units. New and revised specifications are included. New tables of typical coefficients of utilization and light distribution curves have been added to this edition. RLM Standards Institute.

Metal Recovery 283

One of the fields in which ion exchange holds great promise is in the recovery of valuable metals from dilute solutions re-

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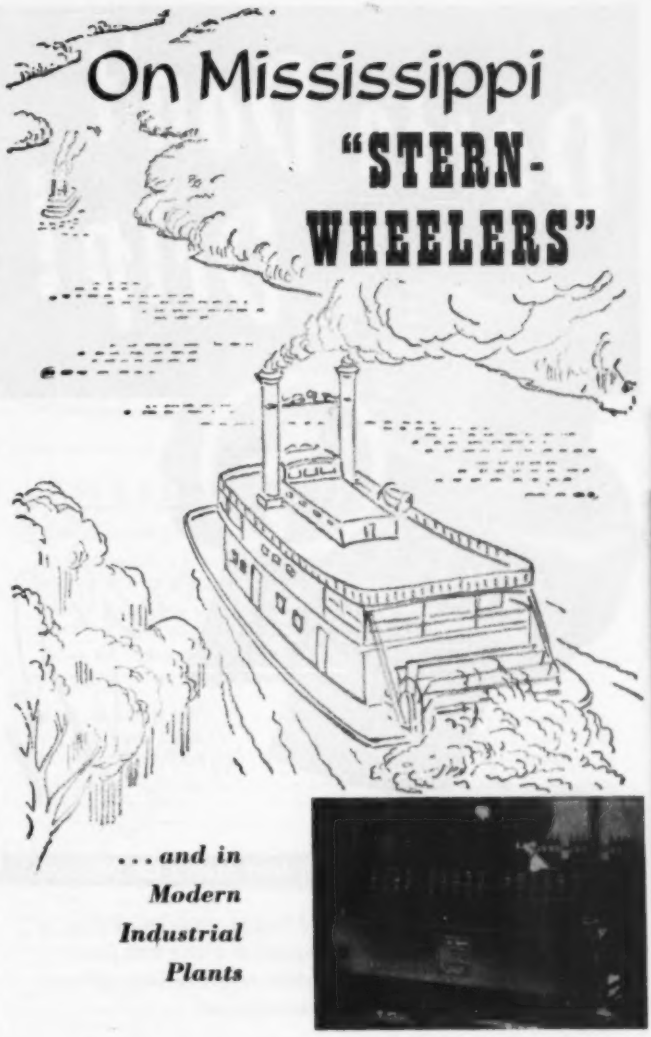

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New bulletins and catalogs

(Continued from page 151)

sulting from various manufacturing processes. Information on the subject is contained in a 9-page reprint 3737-7, "Metal Recovery By Ion Exchange." Tables, charts and other data illustrate some of the forms in which metals are present in solutions, and tell how they could be economically recovered. The Permutit Co.

Oil Booster **284**

Advantages of oil boosters, for heating oils, bituminous or heavy viscous materials, are the subject of 4-page folder AD-108. Units are available with burners for light or heavy oil, or gas. Specifications and typical installations are presented. Road Machinery Div., Cleaver-Brooks Co.

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Heat Treatment **285**

Heat-treating equipment is the subject of 28-page brochure 52. Illustrating the containers, fixtures and retorts more commonly used in carburizing and annealing, the publication also contains installation views of new equipment which has interesting possibilities for reducing handling and heating time. Various types of tubing for annealing, firing radiant furnaces, venting noxious gases and protecting thermocouples also are described. The Pressed Steel Co.

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Ampco Welding News

Applications of bronze welding electrodes are reviewed in this quarterly publication. Although usually a 4-page tabloid, the third quarter issue contains 12 pages. Fifty-two different actual welding applications are pictured and described. Among the applications shown are overlaid gears and pinions, overlaid bearing surfaces and draw dies, fabrication of sheet and plate for wear and corrosion resistant services and welding of dissimilar metals. Ampco Metal, Inc., 1745 S. 38th St., Milwaukee 46, Wis.

SK Engineering News

Technical articles and installation stories contained in this 4-page house organ deal with such equipment as eductors, pumps, condensers, flow meters, valves, and tank heaters. Two of the articles presented in Vol. 4, No. 2 are: "Tank Type Heater Keeps Oil Free-Flowing," and "Thermoid Uses Jet Exhauster to Crack Production Problem in Making Hose." Schutte and Koerting Co., 18 State Road, Cornwells Heights, Bucks Co., Pa.

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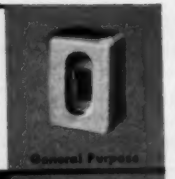

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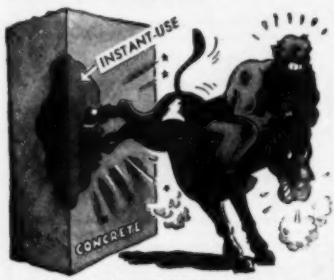

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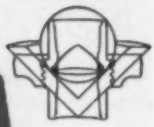

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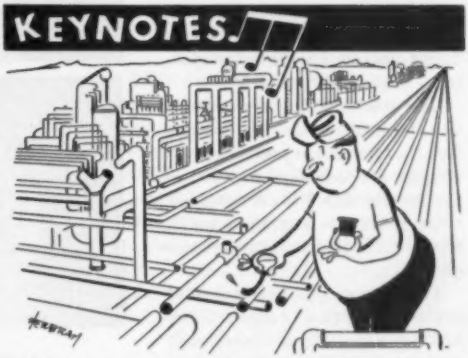

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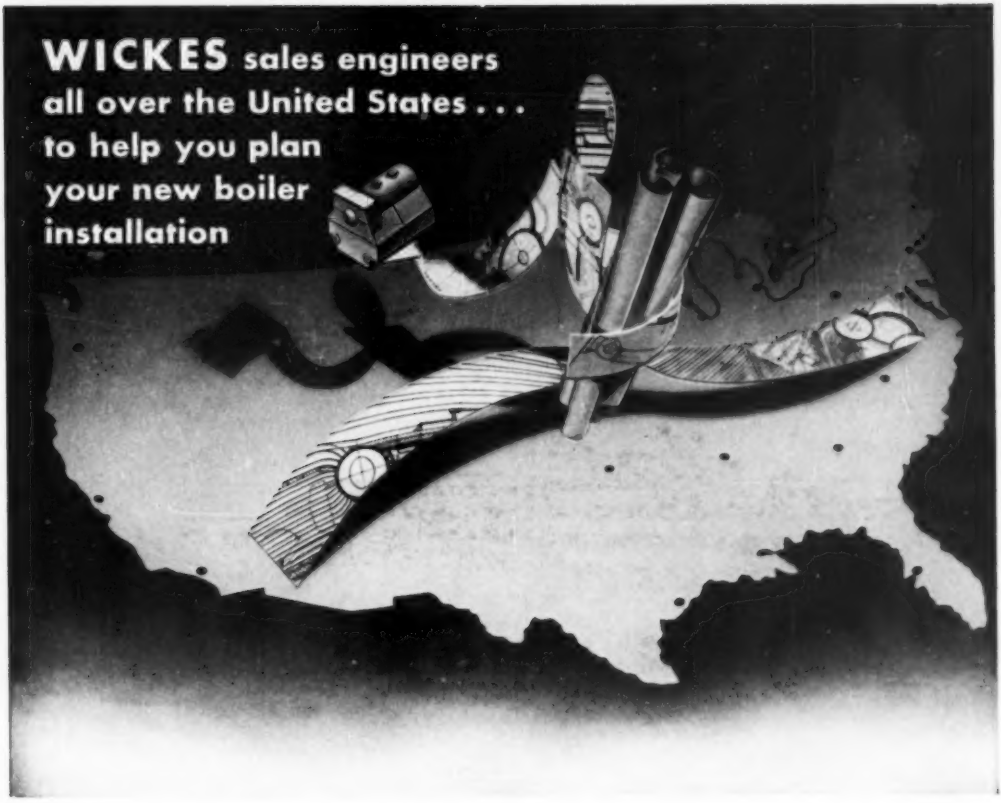

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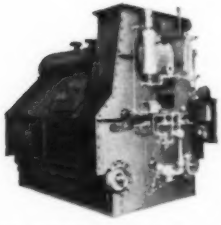

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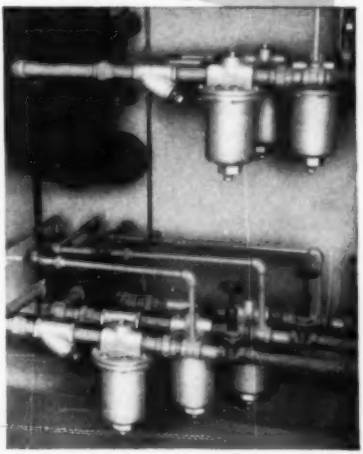

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